



Technical Accomplishments 1986

Continuing a LAB NEWS feature begun six years ago, *Technical Accomplishments 1986* sums up what we, Sandia National Laboratories, consider our principal technical achievements for the year just past.

The work summarized here has been submitted by technical organizations in Albuquerque, Livermore, and Tonopah. No attempt has been made to rank items. The responsible department is given in parentheses after each item.

Weapon Systems

- We are developing materials models and analytic tools to model metal-forming processes. These new capabilities are reducing the cost and time to optimize process parameters at the production agencies. Two- and three-dimensional analyses have demonstrated the application of these tools to analysis of strain localization and die geometry. Polycrystal plasticity modeling is being used to help formulate tools to predict strain localization and anisotropy. The Interagency Metal Forming Working Group initiated by SNLL and LLNL became an official IMOG (Interagency Manufacturing Operations Group) organization in November. It has provided a forum for transferring these tools and technologies to the production agencies, particularly Oak Ridge/Y-12. (8310)

- We completed a multiyear effort to verify that the B-1B aircraft is compatible with the B61 and B83 bombs. Mechanical fit, electrical function, vibration flyaround, and dynamic separation tests were among the activities leading to a nuclear certification for the B-1B. (5120)

- We are developing a sharp-nosed penetrator for high-speed water and ice entry. Use of a pointed penetrator for water entry is a departure from the traditional blunt body, but the high-speed capability can reduce the cost and complexity of water entry systems while enhancing performance. Two important collateral advantages accrue: inherently good ice penetration capability and a single configuration suitable for both water and ice entry. Penetrator behavior has been confirmed through an extensive series of reduced- and full-scale tests in both water and ice to measure impact loads and determine stability for a variety of impact conditions. (8150)

- During a series of experiments in support of several directed energy weapon concepts, we worked on target imaging and localization. The ability to acquire, calibrate, and locate the image centroid

at high frame rates and low frame delays was successfully demonstrated. We have also built and are testing a control system to remove the beam jitter in the precision pointing and controls experiment at LANL, and we have demonstrated a novel way to measure beam point accuracies. These tracking and pointing experiments provide a new capability for the DOE, and address key hardware, software, control algorithm, and image-processing issues. (8430)

- In support of a Phase 2A for a Nuclear Depth/Strike Bomb (ND/SB) for the Navy, we made complete designs using two different nuclear packages. Design changes (16 total) were made from the basic designs for the purposes of trading off design parameters and cost. The trade-offs were characterized through joint Navy/DOE effort (the latter including Sandia, LANL, AL, and all DOE integrated contractors). A joint DoD/DOE Phase 2A report is in preparation. (5110)

- An invention disclosure was filed for a new type of optical proximity fuze. This device sends out a short pulse of laser light and, utilizing a fiber optic delay line, measures the return time of the light reflected from the target. The concept has been breadboarded and proof-of-principle demonstrated. The fuze has the potential of being small and inexpensive. (8460)

- The Peacekeeper Joint Test Assembly system was completed, and the First Production Unit delivered on schedule with no deviations in the performance requirements. This is a highly complex instrumentation system that gathers body motion data for the reentry vehicle as well as fuze and warhead functional data. The system uses a microprocessor-controlled architecture that employs custom-built, large-scale integrated circuits. (8460)

- We continued integration of the W80 Common Warhead into new Navy and Air Force launch systems. The W80-0 is deployed in the Sea-Launched Cruise Missile (SLCM), and the W80-1 is deployed in the Air-Launched Cruise Missile



PENETRATOR DEVELOPED for high-speed water entry blasts off on a two-stage rocket at Barking Sands Facility (Kauai, Hawaii). Open-ocean impact conditions for the penetrator were a velocity of 1000 feet per second and an angle of 20°, relative to water surface.

(ALCM). Compatibility demonstrations between the W80/SLCM and various surface ship and submarine launch systems were conducted during 1986. W80-1/ALCM environmental and launch tests were completed for carriage certification on the B-52H Common Strategic Rotary Launcher (CSRL). Laboratory acoustic and vibration tests were conducted on a W80/ALCM as a part of the B-1B certification program. (5110)

- The W87 Peacekeeper nuclear warhead carried in the Mk21 reentry vehicle was successfully completed on time. All commitments to the Air Force Ballistic Missile Office were met. Likewise, all commitments to the DOE production plants (engineering releases, product definitions, production support, etc.) were met, resulting in smooth transition from development engineering to warhead production. It is noteworthy that all development flight, ground, nuclear effects, and safety tests were completed as planned in this shorter-than-usual four-year development program, and that the W87 warhead was qualified to all use environments when it entered the stockpile. (8130)

- We completed the design of all subsystems and components and their integration into the W88/Mk5 arming, fuzing, and firing (AF&F) assembly. All design engineering releases required to support production schedules were completed as planned, and 19 functional AF&Fs were fabricated and delivered ahead of schedule. All W88/Mk5 assemblies were delivered ahead of schedule to support the first Trident II flight test in January 1987. An intensive test and evaluation program has demonstrated compliance with all design and performance objectives. (5150)

- Increasingly, designers are using investment casting (the "lost-wax process") as an important net shape fabrica-

tion process for production of containers for weapons components. We established an investment casting capability to provide designers with prototypic hardware on a timely basis, and to provide a center of expertise for assisting the design organizations on materials problems associated with the interface among SNLA, the integrated contractor, and the vendor. This capability was successfully demonstrated by producing W88 thin-wall fireset housing castings from 17-4 PH alloy. (1830/7470/2360)

- We developed and implemented a structural modeling technique that combines analytical and experimental models for reentry vehicle systems. The vehicle shell is described by a computer-based analytical model. Since the warhead section is difficult to model, data measured in a vibration/modal test lab are used to model the warhead section. Component mode synthesis techniques are used for coupling the experimental and analytical models. The method was verified using a simulated reentry vehicle structure typical of current technology. We are using the technique to develop an overall system model to evaluate the dynamic response of the arming, fuzing, and firing components of the Trident II/Mk5 system. (1520/7540)

- We developed an all-electronic safing and arming device for the Army's Fiber Optic Guided Missile. This is the first such device to receive preliminary safety board approval for use in a conventional weapon system. We also developed a very high-g data-recording package for use in the development of both nuclear and conventional fuzing systems. The demonstrated performance of this recorder extends our data-gathering capability to acceleration levels of 105,000 g's with a data-sampling rate of 2,000,000 samples per second. (9120/2360/2510/5140)

Components

- Development of the Trident II arming, fuzing, and firing (AF&F) system components continued, and a number of significant development milestones were passed. The programmer exceeded the stringent accuracy requirements for Trident II. The impact fuze was shown to function for extreme values of impact conditions. The fireset demonstrated the precise timing and high output currents required for the W88 warhead. All components were successfully tested underground, and the first flight-test AF&F has been delivered to the Navy. (2300)

- We designed an RLTC (Reserve Lithium Thionyl Chloride) battery that can deliver 9 amps at 30 volts for almost two hours. The RLTC battery is especially significant for its high power and energy density, which far exceeds that of prior weapon power sources. Because of its high energy density, it is difficult to design an RLTC battery that does not explode under severe abuse conditions. Furthermore, thionyl chloride vapors are quite toxic, and complete containment is desirable for applications in a closed environment (such as a submarine). Our initial design exploded when its leads were shorted during activation. Modifications during the year evolved a safer design that only vents thionyl chloride if shorted during activation. We demonstrated the feasibility of complete containment of all toxic material and shrapnel in a second RLTC concept. Both accomplishments are important milestones in our continuing effort to provide a safe power source for weapon applications that require significantly greater power and energy densities than are now available. (2520)

- We developed a new class of epoxy/anhydride encapsulants that are cured with metal complexes. The new formulations are the first Sandia potting components found to be compatible with explosives such as HNS (hexanitrostilbene) and HNAB (hexanitroazobenzene). These new encapsulants are a dramatic improvement over typical amine-cured epoxy encapsulants that have long-term compatibility problems with explosives. These encapsulants exhibit low exotherms and long pot lives, and can be compounded with certain glass micro-balloon fillers to attenuate shock. (7470)

- As microelectronic circuitry becomes increasingly miniaturized, problems develop in the photo-patterning of the circuit elements onto the device surface. One such problem is the loss of pattern definition caused by reflection of the light used for pattern exposure. Addition of a light-absorbing dye to the photoresist used in patterning can ameliorate this effect. A dye with nearly ideal chemical

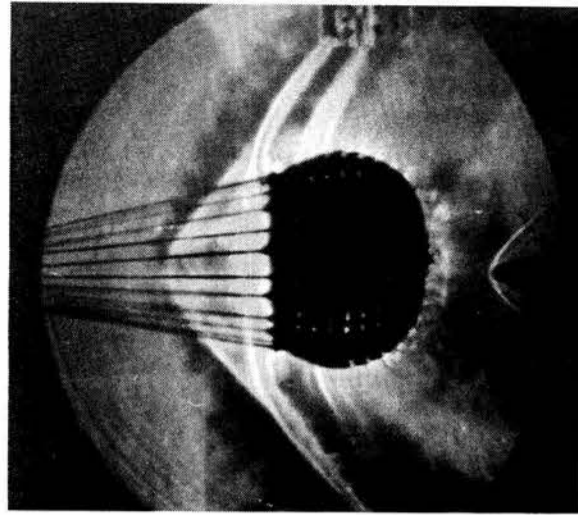
and physical properties was identified, formulated in photoresist, and used in the production of 256K memory circuits. An otherwise unpatternable circuit was produced cleanly with this dyed photoresist. Two patents have been issued, and two photoresist manufacturers have expressed strong interest in commercialization. (1810/2130)

- We developed a method to control weld pool width as a weld is being made. A vision processor makes the width measurement, relying on changes in image brightness that occur at the boundary of the weld pool to detect the edge. An overhead view of the pool, which is geometrically simple from an image-processing standpoint, is made possible by a specially designed gas tungsten arc welding torch. Optics for the viewing system are incorporated into the body of the special torch, which provides a bird's-eye view of the weld. (8180)

- Production of a new class of mercury-activated inertial switches was begun. These switches utilize advanced thin-film and glassing technologies developed collaboratively with materials, processing, and analytical specialists throughout the Labs. The new switches eliminate an old problem affecting most mercury inertial switches — a tendency for switch sensitivity to degrade with time. The production start of the new switch was the successful culmination of a vigorous two-year effort to integrate the new processing techniques into a working facility capable of producing weapons-grade product. (2540)

- We established a technology for real-time optical computing. This technology holds the promise of small, lightweight signal- and image-processing subsystems for future nuclear and conventional weapons. We demonstrated the ability to form radar images in real time using optical and acousto-optical techniques. We also used optics to perform other types of signal-processing calculations, such as correlations or convolutions. These laboratory results were achieved with components that are suitable for application to future weapons. (2330)

- Experiments to study the microscopic chemical and physical processes that occur in explosive reactions produced some of the first real-time spectroscopic measurements in the severe environment of a detonation. These studies are done on compressed granular explosives of the type commonly used in weapon components. Spectroscopic techniques done in less than a billionth of a second have provided information on temperatures, transient and final products, and reaction rates in detonating high explosives. Under-



WIND TUNNEL TESTS helped determine design parameters for a Sandia-developed Mach 2 parachute system to decelerate the Sea Lance Nuclear Depth Bomb. Here, a small-scale (18-in.-diam.) parachute undergoes testing at the NASA Ames wind tunnel.

standing these detailed processes is important for improving our predictive capability in safety, vulnerability, and performance of explosives. (2510)

- CABAL-12 glass has been recommended for use in lithium sulfur dioxide battery headers. Results from a number of use tests demonstrate the superior lithium corrosion resistance of CABAL-12 glass relative to TA-23, its predecessor; battery lifetimes are projected to extend well beyond 25 years. In addition, processing technologies for glass melting and header sealing were established and transferred to potential commercial suppliers. We are now working to formally qualify CABAL-12. The development of this technology is timely, in that the availability of TA-23 glass in the future may be limited to those willing to establish licensing agreements with Duracell. (7470/1840/2520)

- We developed an increased capability in custom-designed integrated circuits (ICs) that will improve the availability and reliability of the components. This capability includes new Computer Aided Engineering (CAE) tools, as well as the circuits themselves. Important additions to the CAE capability this year were, first, layout methods that resulted in physical descriptions superior to expert designer results with much faster updates for changes. Second, important to the high reliability applications that Sandia supports, the CRM's (Center for Radiation-Hardened Microelectronics) ability to simulate faults that might occur in a circuit and then evaluate the effectiveness of test programs to detect these faults was improved a thousandfold. We completed design of a 5000-gate array that improves both functional density and operating speed by a factor of three over previously available circuits. This array is especially designed to be tolerant to total dose and transient radiation environments and to be immune to errors created by cosmic rays encountered in space applications. The engineering workstations at Sandia can be used for developing specific applications. (2110)

- The rapid response of the Center for Radiation-Hardened Microelectronics (CRM) to correct or improve designs for radiation-hardened integrated circuits (ICs) was demonstrated in two instances. A successful correction of a design flaw in the SA2998 nonvolatile memory was accomplished, with devices being delivered for evaluation in two months. A comprehensive redesign of two other ICs used in the Trident II radar yielded working devices for evaluation in the radar subsystem in only five months. Working with sister groups at Bendix Kansas City, we also developed a variety of commercial semiconductors and qualified supporting CAP

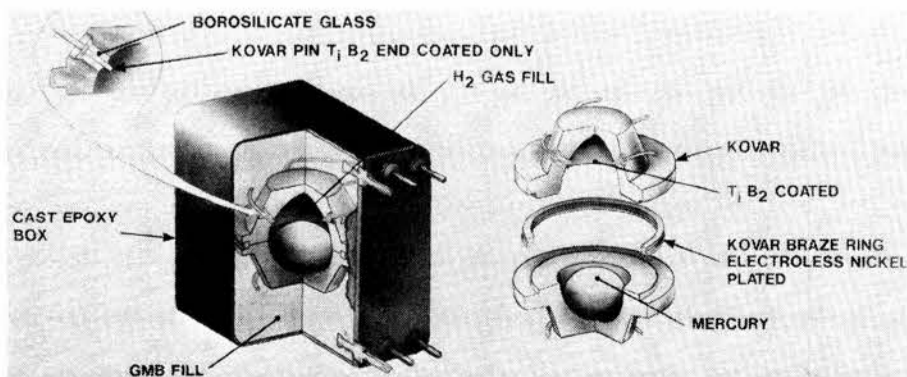
(Code Activated Processor) and Trident II schedules. CRM process specialists, teamed with Bendix Albuquerque Operations (BAO) engineers, solved several fundamental fabrication problems, resulting in enhanced manufacturability of BAO-produced four-micrometre technology ICs. (2150)

- We completed development of a new high-precision crystal clock for use in radiation environments. This clock features new techniques developed at Sandia for radiation hardening quartz, as well as self-compensation of radiation effects in circuit elements. It also includes new processes for mounting the quartz element to provide a high degree of mechanical shock ruggedness. This clock establishes a new level of frequency precision for severe environments. (2530)

- We successfully designed and tested a 5.2-ft.-diameter Kevlar and nylon parachute to decelerate the Sea Lance Nuclear Depth Bomb for water impact. The parachute generates a bomb deceleration load of 52,000 lbs. at twice the dynamic pressure of any other nuclear bomb parachute system in stockpile. Our unique parachute design codes and advanced parachute construction techniques were used to develop this parachute, which meets all major Navy and DOE performance requirements after only 20 rocket-boosted flight tests at Tonopah Test Range. (1550)

- Pilot production began at Bendix Kansas City for the Code Activated Processor (CAP), the next generation of coded switch. The CAP will provide new PAL features, including crypto-communication, for future weapon systems. It replaces the Multiple Code Coded Switch, which has been the successful, dominant PAL switch for a decade. The CAP packages a complete microcomputer and interface circuitry in a volume of only 1.25 cubic inches. This producible and extremely dense package is achieved by using thick-film hybrids with leadless packages, which contain discrete devices, integrated circuits, and a Sandia microcomputer with a five-year, non-volatile RAM (Random Access Memory). (2330)

- One of the most challenging aspects of future integrated circuit technologies is the patterning of metal interconnect lines 2-or-less microns wide over complex topologies. When standard approaches are used, the high reflectivity of aluminum leads to problems such as notching. We investigated two solutions to this problem. With Organization 1800, we developed a photoresist that results in a substantial reduction in reflectivity with little increase in manufacturing complexity. Our second approach to this problem was to establish a capability to sputter very thin anti-reflection coatings on the bright interconnect material. (2140)



NEW CLASS of mercury-activated inertial switches eliminates an old problem: the tendency for switch sensitivity to degrade with time.

Research Sciences

- We used the Sandia-developed imaging and pulsed-laser atom-probe field ion microscope to study, in atomic detail, processes involved in chemical reactions, surface reconstructions, and the growth of strained-metal overlayers. The formation of a stoichiometric oxide was shown to be responsible for the decrease in catalytic activity of rhodium automotive exhaust catalysts during the commercially important CO (carbon monoxide) oxidation reaction. Studies of the motion of individual atoms led to the identification of the fundamental forces that drive the restructuring of single crystal surfaces. Investigations of the morphology and mobility of nickel overlayers on tungsten substrates led to an understanding of the growth mechanism of strained-metal overlayers, a new class of scientifically tailored materials that exhibit novel electronic and chemical properties. (1130)

- We developed parallel-processing computer algorithms that provide a significant new capability for solving highly nonlinear three-dimensional computer models in physics, engineering and materials science, chemistry, and mathematics. These new algorithms for finite element analysis are designed so that the processors in multiprocessor computers work simultaneously on a single scientific problem. The algorithms were demonstrated on a 10-processor ELXSI machine and on a 32-processor Hypercube, and are believed extendable to 1000-processor computers. (1410)

- We developed calculations to explain the effects of tritium exposure on the mechanical properties of copper. This work explains, for instance, why recent experiments found that helium concentrations in tritium-exposed copper samples were much higher than expected, resulting in degradation of the mechanical properties of copper. The new theoretical considerations show that the decay of tritium in the gas results in a supersaturation of the metal with tritium, which easily enters the metal to form bubbles at the grain boundaries. Atomistic calculations using the Embedded Atom Method show that the bubbles weaken the grain boundaries, leading to intergranular fracture. (8340)

- In support of advanced materials development, we developed a new materials characterization technique — X-ray gauging — for nondestructive quantitative analysis. Computer-controlled gauging devices were developed, calibrated, and installed at Bendix Kansas City and at Y-12 (Oak Ridge). These devices have proven to be rapid, accurate, low-cost analytical tools that provide materials quality control at the production facilities. (1820)

- We developed a real-time optical pattern recognition system that recognizes three-dimensional targets from an arbitrary angle of view. It can also detect targets at different distances and of varying brightness. The system uses holographic filters in a coherent optical correlator. The filters are designed on a digital computer using an iterative technique and then fabricated as computer-generated holograms. We have applied this method to specific changes in image rotation, scale, and perspective view. Numerical examples illustrate that the pattern recognition is robust even when noise and

other degradations occur. (8430)

- We used geometric reasoning that couples the geometric constraints of objects being manipulated with sensor feedback to directly drive a robot to perform parts insertion. With a combination of computer vision, adaptive control using force feedback, and geometric reasoning, we were able to carry out insertions of tight-fitting parts without the use of fixturing to guide the parts. (1410)

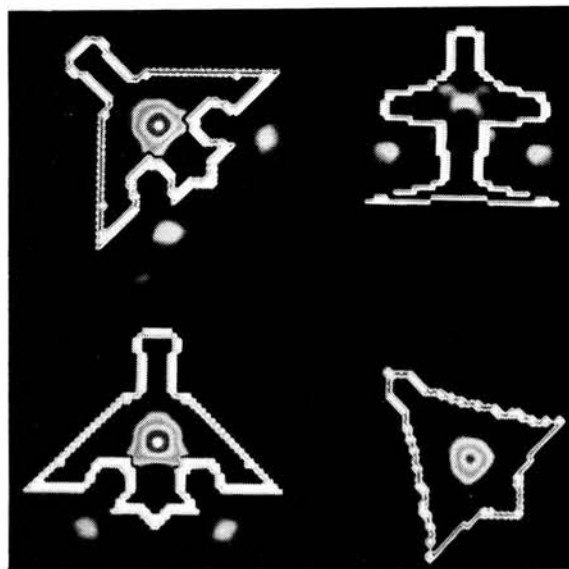
- We used molecular vibrational spectroscopy to identify the structures making up heavy metal fluoride (HMF) glasses and to explain how the addition of zirconium (Zr) increases their strengths. If thorium (Th) is present without Zr, it acts as a weak network former. When Zr is added, it takes over the network-forming function, forcing Th into bridging positions, resulting in glass with improved mechanical strength. The improvement is due to Zr's ability to vary its coordination number and coordination sphere to adjust to the availability of fluoride ions. These glasses have potential applications, such as infrared-transmitting windows and optical fibers, in Sandia components. (1820)

- Surfaces are damaged by radiation-induced electronic excitations, leading to such phenomena as flashover, vacuum gap breakdown, stimulated etching, changes in adhesion, and the desorption of atoms and molecules. Little is understood in detail about these damage mechanisms. We made the first detailed measurements of the internal energy states of neutral desorbates that dominate these processes. Using laser resonance-ionization, closely coupled with theoretical work in electronic structure and dynamics, we have gained a new and detailed picture of molecular desorption from metal surfaces. (1150)

- Parallel-processing algorithms for applications dealing with rocket plume simulation, quantum chemistry, and SDI-related searching problems were developed for a highly parallel computer known as a Hypercube. The Hypercube consists of 32 (expandable to 128) independent processors that communicate over a fast interconnection network. Performance measurements for these applications show a speed-up that is almost linear with the number of processors used. The initial Hypercube version of the searching program (a non-floating-point application) runs virtually as fast as the current Cray 1-S program. (8230)

- We developed another microcellular polymer foam for applications in high-energy physics experiments. This foam is unique because it has an extremely small cell size and because cavities of complex shapes can be molded within it. Cell size as small as 0.1 micrometre has been obtained, which is 10 times smaller than our previous best microcellular foam and about 1000 times smaller than a conventional foam of similar density. The foams are made by gelling a crystallizable form of polystyrene (isotactic) and then extracting the solvent. The ability to "mold to shape" cavities of complex shapes within the foam is important because the cavities cannot be machined, but are required for some experiments. (1810)

- We developed a finite difference code, MARFLO, to study the surface-tension-driven convective flow inside a



REAL-TIME optical pattern recognition technique detects three-dimensional targets from an arbitrary angle of view. The method is applied to specific changes in image rotation, scale, and perspective view.

weld pool produced by a high-power pulsed laser. It is believed that removal of the vapor plume, which interacts with the incoming laser beam, prevents defocusing of the beam. MARFLO uses a boundary condition to model hypothetical beam intensity distributions for analyses of beam-focusing effects. When the beam was defocused, MARFLO simulations indicated that convective cells generated near the pool center could transfer heat from the surface more effectively and produce deeper welds. This discovery has great significance for practical application of laser welding. (1510)

- We achieved an unprecedented degree of etching selectivity between very similar semiconductor materials by using photochemical etching processes that depend on the electronic properties of the near-surface region of the semiconductor. Almost total selectivity between two chemically similar materials can be achieved by choosing reaction conditions that dif-

ferentially control the generation of carriers in the near-surface region or the availability of carriers at the surface subsequent to their generation. This ability to discriminate between chemically similar, but electronically dissimilar, materials should be widely applicable in device fabrication. (1120)

- We demonstrated a radically different, one-shot, pulse-power supply based on shock wave activation of electrochemical cells. With a submicrosecond initiation time and pulse durations of hundreds of milliseconds or longer, such a power supply can furnish power in a time regime not possible with prior devices. These shock-activated batteries make the unusually high energy density of electrochemical cells available from materials that remain inactive for extended periods. The fundamental processes involved in these batteries have been demonstrated in an extensive research program on electrochemistry under high-pressure shock loading. (1130/2510/ 2520)

Energy

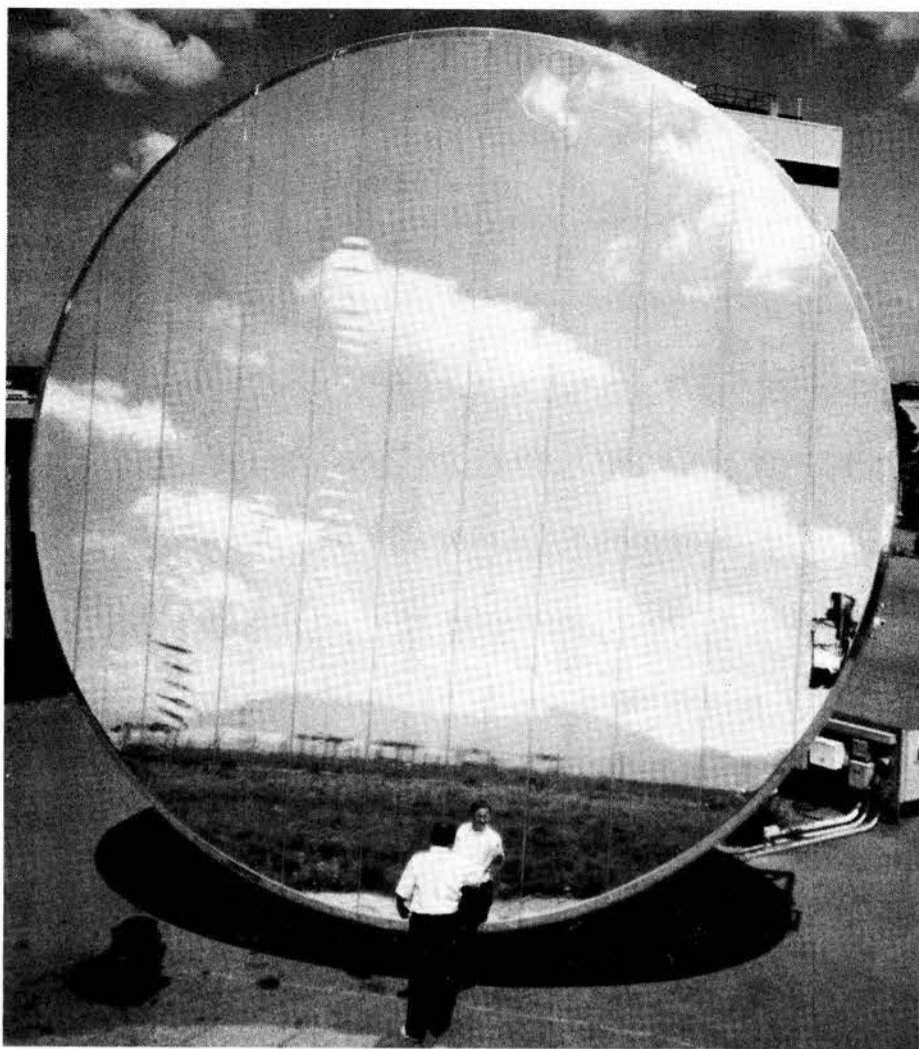
- We demonstrated successfully the RAPRENOx (RAPid REduction of Nitrogen OXides) process for eliminating NOx from gas streams. RAPRENOx is a chemical process that, unlike present exhaust-cleanup methods, neither uses strategic materials nor is sensitive to the concentration of oxygen in the exhaust. We used both fundamental chemical studies and applied tests with real diesel exhaust to characterize RAPRENOx, and found that it removes virtually all NOx from the sampled stream. The process is expected to have a major positive impact on the heavy-duty diesel industry, and should also be useful for many other types of combustors and in the chemical industry. (8350/8360)

- The first prototype of a radically new sun-tracking mirror (heliostat) for use in solar power tower plants was recently installed at the Central Receiver Test Facility (CRTF) for evaluation in FY87. The new concept uses a silvered polymer (acrylic) film glued on a thin metal membrane that is stretched over a larger-diameter (27ft.), stiff metal hoop. A second membrane on the back of the hoop allows the space between to be evacuated to provide a concave, focused shape to the reflective surface. The focusing system can also quickly pressurize the space between the membranes to defocus the mirror for safety procedures. Preliminary tests at the CRTF showed that the prototype mirror module produced a good image, and the focus control system dy-

namically compensates for variable wind loads to maintain image quality. Additional tests are underway. Major advantages of this type of mirror are its light weight and its simplicity. We expect these features will provide cost savings of at least 50 percent over state-of-the-art glass/metal heliostats, the most expensive system in a power tower plant. We plan to eventually build and test prototypes up to about 45 ft. in diameter. (6220)

- The Sandia magnetic fusion energy groups at Livermore (8340, 8310) and Albuquerque (1110) characterized the plasma-facing surfaces of graphite tiles removed from the Tokamak Fusion Test Reactor (TFTR) at Princeton Plasma Physics Laboratory. Substantial deposits of metals sputtered from surfaces of nearby components and deuterium from the plasma were found on these surfaces. These findings, along with laboratory studies of tritium retention, sputtering, and outgassing of graphite, have enabled us to better understand the performance of these plasma-facing materials and to predict the invessel tritium inventory in TFTR when tritium plasmas are first used in 1990. (8340)

- We participated in the last major experiments of the International Seabed Working Group with the launch of six seabed penetrators off the southern coast of France in November. The purpose of the three-week campaign was to discover how much soil disturbance is created by the impact and burial of a seabed penetrator



NEW SUN-TRACKING MIRROR uses a silvered polymer film glued on a thin metal membrane stretched over a stiff metal hoop. Because of its light weight and simplicity, the mirror should provide significant cost savings over glass/metal heliostats — the most expensive system in a solar power tower plant.

capable of carrying high-level nuclear waste. The Sandia penetrators achieved velocities of 45 m/s and burial depths of 15 m while measuring the penetration resistance of the soil and deploying a trailing wire and a sonar marker. Later the impact sites were located by a geotechnical platform that probed the soil and removed core samples. Preliminary evidence indicates that our penetrators created minimal disturbance, leaving soil properties nearly unchanged. These data will be important to a preliminary assessment of the effectiveness of ocean sediments to isolate nuclear waste from the biosphere, perhaps offering an alternative to land-based disposal. (6330)

- We demonstrated the use of a methodology for assessing the long-term performance of a high-level radioactive waste repository in basalt formations. Seven potentially disruptive scenarios were analyzed. This methodology is an extension of an earlier one developed and demonstrated for repositories in bedded salt. The new methodology considers flow and radionuclide transport in fractured media; the previous one treated only porous media. Research is underway to develop a methodology applicable to unsaturated tuff formations. (6430)

- Results of hydrologic testing conducted at the WIPP (Waste Isolation Pilot Plant) site, including hydraulic interference tests performed on the scale of several square miles, and the subsequent interpretation and modeling of the Culebra aquifer indicated the importance of incorporating previously neglected processes. Detailed numerical modeling with the SWIFT II computer code revealed the likely presence of a high-permeability path leading from a portion of the WIPP site to the site boundary. Within this zone, fluid flow is apparently controlled by flow through fractures rather than flow through a porous medium. The detailed numerical modeling also revealed the importance

of considering the effects of the WIPP shafts on the local WIPP hydrology. The consequences of these interpretations are important for solute transport calculations and performance assessment efforts at the WIPP site. Previous hydrologic modeling relied on simple porous-medium assumptions, neglecting such considerations as variable fluid density, differences in aquifer elevations, vertical fluxes, and fractures within the predominantly dolomite formation. (6330)

- Through a series of laboratory experiments, we demonstrated the technical design basis for second-generation *in situ* retorting of oil shale. Specifically, we showed that the inevitable variations in voids that result from blasting can be overcome by control of particle size during fragmentation. Through these new design concepts, the possibility exists that future *in situ* retorts can be operated with improvements in nearly all processing parameters of anywhere from 30 to 100 percent, compared to retorts that were operated in the late 70s and early 80s. (6250)

- To support the Nuclear Regulatory Commission's decision making on severe accidents in commercial nuclear power plants, we led an effort to evaluate the risk from nuclear plant operation in the United States. A key objective of this work is to incorporate the full body of information that has become available on severe accident phenomenology and systems behavior since the Three Mile Island accident. Principal accomplishments during the past year include: (1) developing containment event trees that describe, far more effectively than ever before, the thousands of accident progression pathways that can result in threats to containment; (2) formulating and implementing a risk uncertainty methodology that has led to a much more comprehensive understanding than previously available of the magnitude and character of the uncertain-

ties; and (3) developing an integrated set of computer codes that more easily enables detailed evaluations of risk and greatly facilitates investigations of the effects of proposed plant design or procedural changes on risk. Thus far, analyses have been completed on four reference plants. Some of the foremost experts in the country have reviewed the work and provided input to the study. (6410)

- Our research on the physics of hydrogen/materials interactions led to a better understanding of plasma conditions in the Princeton TFTR (Tokamak Fusion Test Reactor), which has the objective of achieving the break-even point for controlled thermonuclear fusion. Record temperatures with high confinement times were achieved for deuterium discharges in the newly discovered "super shot" mode of operating TFTR. This mode results after using helium-conditioning discharges that contain large amounts of carbon. By measuring ion-induced release cross sections, we showed that energetic C (carbon) ions are 10 times more efficient at removing deuterium from the graphite limiters than is He (helium); therefore, the C component of the He/C plasma is mainly responsible for the conditioning benefit. Operation with tritium plasmas will be required to demonstrate thermonuclear breakeven in TFTR, and inventories of radioactive tritium must be restricted. Our first measurements of hydrogen isotope inventories in both the near-surface and bulk regions of the TFTR graphite limiter show: (1) near-surface tritium retention resulting from plasma bombardment will be a small fraction of the five grams allowed on site, (2) a larger fraction of tritium can build up over time in the bulk of the graphite limiter, and (3) a large concentration of naturally occurring hydrogen is responsible for the long times required to change from hydrogen to deuterium plasmas. These findings are helping to formulate future operating scenarios for TFTR and other large tokamaks. (1110)

- We conducted experiments to simulate severe nuclear power reactor accidents to determine the adequacy of containments and the amount of radionuclide release beyond site boundaries in the event of containment leakage. A number of large-scale tests were conducted to (1) determine the penetration and radionuclide release from molten core debris interacting with containment base mats, (2) determine the threat to containment from hydrogen detonations and the transition processes by which accelerated flames lead to detonation, and (3) understand the physics of steam explosions to determine their threat to containment integrity. A new 1/10 scale model of a containment building was constructed and tests initiated to study the potential threat to a containment building from molten core debris blown from a reactor vessel at high pressure. (6420)

- In the course of the development of the Nuclear Regulatory Commission's (NRC's) CONTAIN computer code, we made an important step in understanding the phenomenon of direct containment heating in severe reactor accidents. In this process, molten debris ejected from the reactor pressure vessel at high pressure into the containment building can react with the atmospheric gases and generate pressures that may threaten the integrity of the containment building. We developed a model for the interaction of the debris with the gases, and incorporated

it into the best-estimate CONTAIN code. Agreement between the code and scaled experiments at Sandia's Surtsey facility was excellent. Insights gained from the use of the model have helped the NRC to evaluate the importance of this phenomenon and the research needed to resolve this issue. (6440)

- We conducted numerical studies of ventilation in a waste repository in support of the Nevada Nuclear Waste Storage Investigation (NNWSI) project. These studies, using the Sandia-developed computer code, SAGUARO, demonstrated the economic benefits of a cyclic- versus a constant-ventilation schedule. We also demonstrated the possibility of postponing or preventing convective transport of contaminants away from the waste canister by use of drift ventilation. (1510)

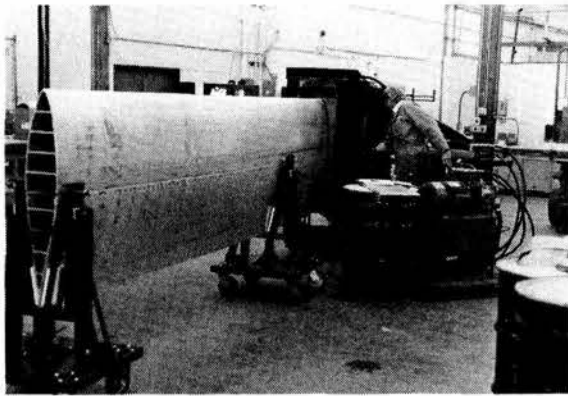
- We developed, in cooperation with researchers at Stanford University and in Advanced Laser Technology Division 1124, a system for injection-seeding Nd:YAG (Neodymium: Yttrium Aluminum oxide Garnet) lasers. This highly compact system consists of a diode-laser-pumped monolithic Nd:YAG laser, a permanent magnet Faraday isolator, and feedback stabilization circuitry. It has proved very effective for stabilizing commercial Nd:YAG lasers. The technology developed under this effort has led to a commercially available product for injection-seeding Nd:YAG lasers for applications requiring highly reliable single-frequency laser systems. (8350)

- We prepared a design handbook for solar central receivers based on 12 years of technology development. The handbook incorporates data from experiments in the United States, Spain, France, and Italy. It describes analytical design procedures for selection and evaluation of technical options. The handbook was prepared as a resource for electrical utilities and other organizations that wish to evaluate central receivers and as a technology primer for educational institutions. (8130)

- We developed the Downhole Periodic Seismic Generator as a scientific instrument for detecting geological structures and underground liquids at depth in the vicinity of a borehole. The original application is for scientific studies related to the Continental Scientific Drilling Program. The oil industry has considerable interest in this device for evaluating reservoirs and for exploration. Joint industry tests of this instrument have been planned or run with Chevron, Amoco, and Sohio. Sandia is currently investigating ways of transferring this technology to private industry. (1540)

- We performed the fourth and final experiment in a series of tests on the Annular Core Research Reactor to study core-melt progression in a nuclear power reactor. In these tests small bundles of reactor fuel rods and control elements were heated to high temperatures in a flowing steam environment, resulting in melting and rapid oxidation of fuel cladding, production of hydrogen, relocation of fuel and cladding, melting and relocation of control structures, and formation of blockages in the flow channel. The last two tests involved fuel and control rods of both pressurized and boiling water reactors. Following this test series, we began another series to accurately measure radionuclide release from fully irradiated fuel rods during meltdown conditions. Data from these tests are used to validate detailed computer models being

BIG BEND FOR TEXAS: a 42-in. chord blade section of a 165-ft.-tall Vertical Axis Wind Turbine for a research test bed in Texas. The chord is nearly 50 percent larger than any previously bent.



developed to predict, among other things, the consequences of severe accidents. (6420)

- In support of DOE's selection of Yucca Mountain in Nevada as one of three sites to be characterized for the nation's first commercial nuclear-waste repository, we played a major role in the development of a Site-Characterization Plan to be submitted to the Nuclear Regulatory Commission (NRC). We developed a systems approach for determining the information needed from the site-characterization activities. We completed descriptions of the rock-mechanics characteristics of the tuff rock and a summary of the repository design. In addition, we developed technical approaches for demonstrating that any releases of radioactivity over the next 10,000 years will be severely limited and that the groundwater travel time to the accessible environment will be longer than 1000 years. The Site-Characterization Plan will be used for review by the NRC, the states, and the public in mid-1987. After it is issued, construction of an exploratory shaft at Yucca Mountain can begin. (6310)

- During and following the Chernobyl reactor accident, we were involved in a time-urgent evaluation of the damage observed as well as in development of a credible scenario for the actual sequence of events that preceded the explosions. Several briefings were given and a Systems Research Report was issued. (9110)

- Our Seafloor Earthquake Measurement System, deployed offshore Long Beach, Calif., for the past 18 months, successfully recorded seismic data from two significant earthquakes during July 1986. Data from these two events, which were also recorded by both land-based and offshore platform instruments, provide a unique set of information that is poten-

tially useful for designing offshore platforms. (6250)

- Based on a new concept for logging hot geothermal wells, several instruments were developed and used successfully to log a deep well in the Salton Sea, Calif., area. Currently, most logging tools and cables are limited to operation at temperatures below 300° C. We designed instruments that could function remotely (that is, without electrical contact with the surface) by storing or recording data on board, and to protect the critical elements of those tools with heat shielding. A family of "slickline" tools was built to measure and record temperature, pressure, and flow velocity. We assembled and used mechanical- and electronic-memory tools to log the Salton Sea scientific well to a depth exceeding 10,000 feet where temperatures of 350° C were measured. Commercial suppliers fabricated most of the components; as a result, the technology has been transferred to industry and the tools are now commercially available. (6240)

- We have successfully extruded the blades, the most crucial element in the entire design, for the new 500kW, 165-ft.-tall Vertical Axis Wind Turbine (VAWT), a research test bed being constructed at Bushland, Tex. In the process, we pushed aluminum extrusion technology beyond previous limits. The VAWT blades, with seven extrusions and three different chord lengths, are the largest turbine blades ever extruded; the largest of the blade extrusions is one of the largest single extrusions ever attempted by the aluminum industry. We have also successfully bent the assembled 42-in. chord blade section in preparation for assembly of the entire blade in a troposkien (turning rope) shape. (6220)

Reimbursables

- We developed and tested a prototype electromechanical alignment mechanism for a satellite instrumentation system for the DoD. This device permits autonomous 1 arc-second adjustment for on-orbit alignment of precision optical components. With such a capability, instrument pointing errors created by thermally induced spacecraft structural distortions can be continually corrected as a function of time of day and season. This mechanism is being designed into future operational satellite payloads. (9220)

- In January, we began development of the Airborne Remote Operated Device (AROD), a small hover-capable, ducted-fan aerial reconnaissance vehicle for the U.S. Marine Corps. AROD will be used as a mobile reconnaissance, surveillance, and assessment platform. AROD includes an embedded microprocessor-based autopilot, fiber optic communications, rugged electronics, and a high performance (for the weight) airframe and control sur-

face design. The first AROD unit was tested in December. (5260)

- We developed a new material description that allows accurate modeling of large-deformation structural problems. The material model, developed for the U.S. Army, uses a continuum mechanics approach and appropriate laboratory tests to define a strain rate and temperature-dependent plasticity model that has proved successful when implemented into the NIKE finite element code. Computations that predict the response of the soft copper and nylon that are used on artillery shells have agreed well with lab and field testing. (8240)

- The Sandia Inertial Terrain-Aided Navigation (SITAN) algorithm was successfully demonstrated in the Advanced Fighter Technology Integration (AFTI) F-16 aircraft at Edwards Air Force Base in September. The purpose of the joint Air Force, NASA, Navy, and Army AFTI program, managed by General Dynamics,

is to demonstrate advanced avionics capabilities being considered for future-production attack aircraft. We developed the AFTI/SITAN algorithm under a reimbursable contract with the Air Force Avionics Laboratory, Wright-Patterson Air Force Base. (9130)

- We developed a concept for detecting counterfeiting of documents for the U.S. Bureau of Engraving and Printing. The concept involves reading multidimensional random features of a document, encrypting the description, and printing it on the document. Authenticity is verified by decrypting the description and correlating it with a reading of the pattern. (9110)

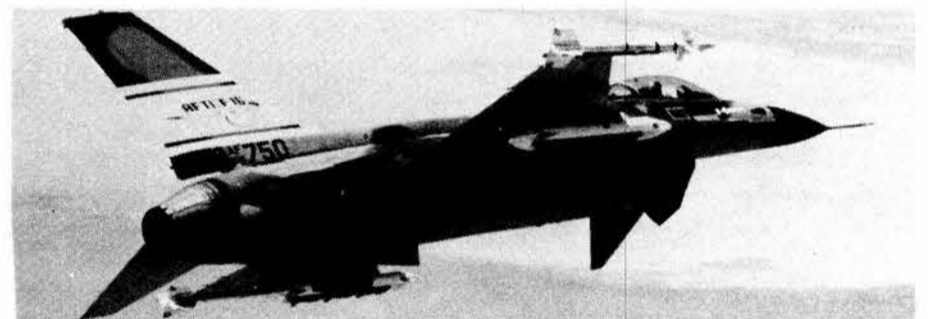
- We completed development of an Ada software engineering environment to support computer code development for DoD ground station processing of satellite sensor data. Ada is a new, sophisticated language that has been mandated for use in all DoD mission-critical systems. Ada software tools have been implemented and installed in a network of super microcomputer workstations to provide the support environment for projects that will result in the production of approximately 500,000 lines of executable code. (9220)

- The Army wants to reduce cost and increase accuracy of existing land navigation systems. Terrain-aiding is one means to bound the inherent drift of existing inertial land navigation systems. Under

a reimbursable contract with the Army Avionics Research and Development Activity at Fort Monmouth, N.J., we designed, integrated, and tested a land navigation system that gives accuracies of less than 100-m median radial error over gently rolling terrain, and has a projected production cost of about \$50,000. (9130)

- We completed several significant performance upgrades on our laser calibration facility that is used to stimulate on-orbit satellite sensors. Algorithm enhancements for computer-controlled pointing of the 30-in.-diameter telescope beam director now allow continuous (24 hr./day) operations to be conducted for payloads on both synchronous and nonsynchronous satellites. Precise laser firing times are now possible using the NAVSTAR/GPS time standard. We also implemented sequential, synchronized firing of dual high-energy lasers, using a fast mirror translator system. (9220)

- We developed methods that give computers the capability to automatically detect problems or failure aboard orbiting satellites, pinpoint the problem area, and command the satellite into a configuration that will work in spite of the problem. The methods are currently being implemented in ground-based computers used in processing data received from Sandia instrumentation payloads aboard certain satellites, but will be designed into satellite payloads of the future. (9210)



SITAN (Sandia Inertial Terrain-Aided Navigation) algorithm was successfully demonstrated in the Advanced Fighter Technology Integration (AFTI) F-16 aircraft in September.

Treaty Verification Technologies

- We are conducting research for DOE and DoD on technologies and concepts for on-site inspection that might be required by future nuclear arms reduction treaties. As part of this research, we constructed a full-scale demonstration model of an inspection facility to test the technologies and concepts under investigation. The model facility was constructed in three months to meet an important government milestone. The model includes a perimeter barrier for intrusion detection and inspection portals for monitoring movement of traffic into and out of the facility. (9110/5210)

- Requirements for instrumentation systems for future satellite applications include less power, weight, and volume, and greater tolerance to background radiation and other threats. We are designing a small family of microelectronic devices to help accomplish this goal. The first of the family has been built and tested successfully in prototype quantities for use on Global Positioning System satellites. One of these new devices will replace more than 100 similar electronic parts, at about one-tenth the power and volume of the parts replaced. (9210)

- We completed the engineering evaluation of the highly successful DOE Regional Seismic Test Network, and demonstrated the ability to monitor nuclear testing with seismic stations located in countries that are party to a treaty restricting underground testing. The network consisted of five National Seismic Stations — two in Canada and three in the eastern part of the U.S. The National Seismic Stations are Sandia-designed, state-of-the-art seismic stations that can operate unattended in host countries and deliver authenticated data to a verifying party. (9110)

- A unique 25-element, short-period seismic array, designed and developed by Sandia and dedicated in Norway in 1985, has generated data for analysis by U.S. and other government agencies and is now considered a world standard in seismic array technology. This array operates unattended and transmits authenticated data via satellite in a manner similar to the earlier, single-element National Seismic Station. It will be the baseline for a seismic array design that could be placed in the Soviet Union to monitor compliance with treaties restricting underground testing. (9110)

Pulsed Power Development

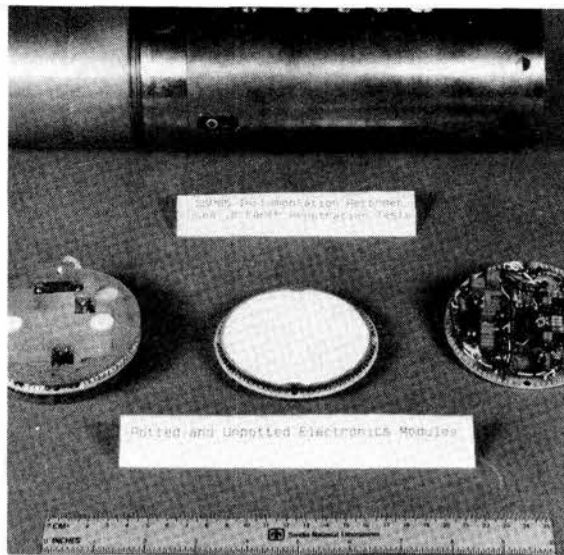
• We developed a new concept for the generation of high-power microwaves based on magnetically insulated, vacuum transmission line (MITL) technology. Numerical modeling indicates that 100 gigawatts or more might be realized from a single tube. Applications for this device include microwave directed energy weapons and compact charged-particle RF accelerators. (1230)

• One of the most promising lithium ion sources for light ion fusion experiments is an electrohydrodynamically driven liquid source. In this source, application of a high electric field to the liquid surface produces an electrohydrodynamic (EHD) instability. The surface deforms unstably into an array of cusps separated by a distance that is the wavelength of the dominant instability. The electric field enhancement at the cusp tips can be large enough to cause field evaporation of ions from the liquid surface. Calculations show that if the applied electric field is larger than 10 MV/cm, the cusps should form on a nanosecond time scale, with spacings of less than 0.2 micrometre. This principle has been used successfully elsewhere to produce single- and linear-liquid metal ion sources. As part of

an effort to develop an EHD-driven source for the Particle Beam Fusion Accelerator (PBFA II), we began diode experiments with liquid lithium and liquid lithium nitrate anodes on a low-energy accelerator (PI-110A). (1240)

• We invented and tested a new type of plasma opening switch. The switch uses plasma constrained by a magnetic field for current conduction, and magnetic "push-back" of the plasma for current interruption. In this design, sensitivity of operation to plasma parameters is decreased. We completed a proof test on the Super Mite accelerator, and began initial design of a larger version of the switch for PBFA II. The potential of this switch for compression of long power pulses appears high. (1260)

• PBFA II successfully completed its first year of testing. The Marx generators, laser-triggered switching, and multi-channel water switching are working well. The accelerator was given an I-R 100 Award for Innovation. An operating point for one full-power, fully diagnosed experiment per week was achieved. We characterized accelerator problems and successfully implemented contingency plans to meet the test schedule. (1250/1260)



HIGH-ACCELERATION earth penetrator data acquisition system survived shock loads greater than 12,000 g's.

water trajectories onboard a test unit. (5170/ 5140)

• We developed an airborne digital signal processor that significantly reduces the information bandwidth required for vibration measurements. A peripheral benefit is that the data are presented in digital form, amenable to encryption. The microprocessor-based device accepts three relatively broadband measurements and converts the analog data to amplitude-time-frequency information through fast Fourier transform. The data are presented in continuous real time without requiring post-test processing. (5140)

• We developed a dynamic radar test for use in stockpile system evaluation of the B61 and B83 weapons. The radar rack has the capability for dual- or single-channel operation. The equipment continuously displays elevation change via a seven-segment display and monitors fire pulse phenomena to record height of burst for analysis. An Intel 8748 microprocessor is the heart of the system. (7260)

• We developed a new method of simulating the dynamic loads associated with water entry and subsequent underwater trajectory. Dynamic load data on full-scale test items can now be obtained in the laboratory, versus testing in the open ocean, resulting in significant savings. In practice, a full-scale water entry vehicle is dropped from the 185-ft. drop tower in Area III to achieve the desired impact velocity. The test item impacts a Hopkinson Bar that imparts a high-amplitude, short-duration shock similar to actual water entry. Aluminum honeycomb surrounding the Hopkinson Bar provides a

longer-duration load that simulates the drag phase of the underwater trajectory. (7530/7540)

• Development of the ACE (Alternate Common Equipment), a microprocessor-based control system, enabled the interface of commercially available high-speed transient waveform digitizers with an existing command and data network at the Nevada Test Site. One ACE allows either local or remote set-up and control of up to 32 digitizers and will enable the automation of both system diagnostics and channel calibration. An auxiliary chassis provides long-term memory for local data backup and also generates a multiplexed data stream that is transmitted to a remote recording facility for subsequent playback. This system moves valuable test data to a safe location immediately after the test and allows rapid access to that data. (7120)

• Multi-channel, high-frequency vibration controls were used successfully for the first time in simulation of reentry vibration on the W88/Mk-5 system in 1986. Multi-shaker excitation is required on reentry vehicles because of the strong variation between the responses at the nose and at the base. The control theory and the computer software were developed at Sandia for multiple-shaker, random-vibration testing up to 2000 Hz. This unique-to-Sandia capability is extendable to the coherent control of simultaneously forced excitations in three axes. This capability will make many types of random vibration tests more realistic. (7540)

• We developed a reliable, high-power (5 TW) X-ray source on the Proto II accelerator. This tripled the dose rate



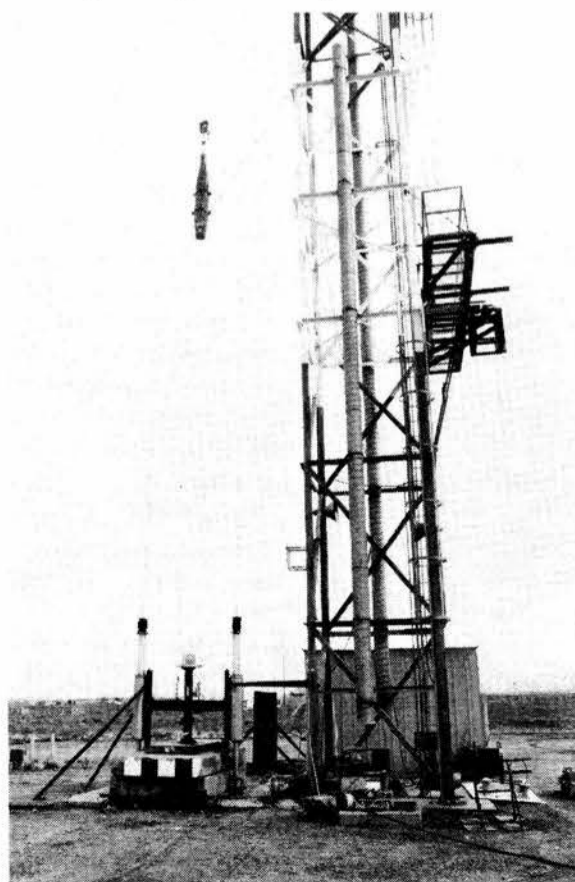
JUST SHOCKING — Surface electrical flashovers put on spectacular display during test firing of the Particle Beam Fusion Accelerator (PBFA II).

Testing

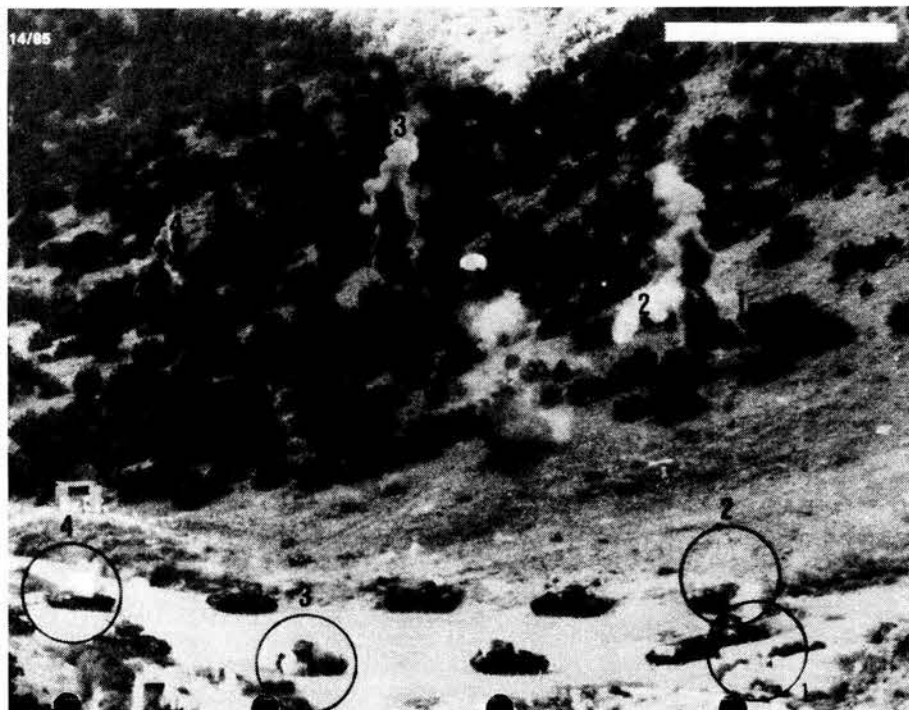
• We fielded a high-resolution, high-frequency earth penetrator data acquisition system that obtained good-quality acceleration and strain data. The strain data have been of particular interest to the experimenters and should improve their understanding of penetrator strains. The digital data acquisition system recorded data while surviving shock loads greater than 12,000 times gravity. The system was packaged in a penetrator that was fired into

rock from the Davis gun at Tonopah Test Range with an impact velocity of 1600 feet per second. (5140)

• We completed the design and environmental qualification of an instrumentation system that uses rate gyroscopes and accelerometers to measure Sea Lance Nuclear Depth Bomb body dynamics after water entry. It has not previously been possible, after the shock associated with high-speed water entry, to measure under-



BEFORE DROP TEST to simulate dynamic loads associated with water entry and subsequent underwater trajectory, a full-scale test shape is suspended from guide wires on the 185-ft. drop tower in Area III. Upon impact, the test shape receives a shock similar to that received during actual water entry.



FOUR SFW (Sensor Fuzed Weapon) Skeet warheads hit tanks after deployment from a Skeet Delivery Vehicle (SDV) dropped from a Sandia aerial cable.

over that available at existing Sandia facilities, an increase crucial to successfully testing Trident II subsystem hardware. The Proto II experiment provided data on vacuum power flow and ring diode operation that were important for designing Saturn, a 25-TW X-ray facility currently under construction. The Proto II modifications also enabled X-ray laser experiments to be done at higher accelerator energies. (1230)

- The installation was begun of protected transmission systems for intrarange tracking data at the Tonopah Test Range. Previously, radar data were transmitted to the control point on open microwave links, combined with other data, then sent via UHF radio link to all range instrumentation: telemetry, cameras, and trackers. The radio links presented a potential for sophisticated eavesdropping. To thwart such attempts, two major modifications were initiated. The first replaces the microwave links with protected fiber optics for radar position information and bore-sighted TV video. The second modification protects the omnidirectional UHF link with encryption devices at the control point transmitter and at each of 40 receiving sites. For this link, the 525 square miles of the Range and the mobility of the instrumentation stations precluded the use of protected fixed-transmission paths, and data encryption was necessary. Full operational capability of the protection systems is anticipated in 1987. (7170)

- We completed the process development and fabrication of pieceparts for the Force Balance Integrating Accelerometer (FBIA) centrifuge tester turntable assemblies. The fabrication effort required processing development and craftworker skills well beyond normal levels, and resulted in pieceparts and assemblies with tolerances held closer than the rated capability of some of the machine tools that had been used. The new Mauser KMZ Coordinate Measuring Machine was used to verify wheel and assembly dimensional requirements. All project schedules were met. (7480)

- With Explosive Subsystems Division 2512, we developed an automated system for measuring the depth of jet penetration of flexible linear-shaped charges (FLSCs). The system uses a simple ultrasonic scanning technique to scan the grooves produced by the FLSCs and a personal computer to find the maximum depth of the groove. A plot is produced

that gives maximum depth versus length along the groove. The automated system replaces manual measurements (using a micrometer) that consumed time and produced fewer data points. The system has been so successful that some of the production agencies requested permission to duplicate it. (7550)

- Laser Tracker-II (LT-II) became fully operational in October as a dynamic vehicle tracker for both restrained and free-flight tests at the Coyote Canyon Test Complex Facilities — rocket track, aerial cables, etc. The new tracker provides near real-time, three-dimensional tracking information and range command control based on preset performance windows. LT-II represents a 3- to 10-fold accuracy improvement over LT-I. A measurement error of less than 0.17 percent was verified for a velocity of more than 3000 feet per second. (7520)

- Working with the Defense Nuclear Agency (DNA) and its contractors, we developed "simulation fidelity," a methodology that, in general, helps us to prepare experiments so underground tests are more tightly focused on the problems the tests are designed to solve, and later, helps experimenters better understand test results. Specifically, the methodology allows us to judge the validity of how we test the effects of ionizing radiation (both aboveground and underground) on military hardware. Through a series of experiments and analyses, we applied the simulation fidelity technique to determine the validity with which we test reentry vehicle components using X-ray radiation simulators such as DNA's Blackjack V or Python and SNL's Proto II. Even though the radiation spectra of the laboratory simulators do not replicate the threat spectra desired in X-ray survivability testing, the simulation fidelity methodology demonstrates that we can nevertheless perform valid tests aboveground and tells us which spectral ranges are acceptable and which are not. One immediate result is that the fidelity methodology may be used to determine acceptable X-ray spectral ranges for high-fidelity testing of Trident II hardware using SNLA's new X-ray simulator, Saturn, which is scheduled to be operational in 1987. (1230)

- Unique testing capabilities at the rocket sled and aerial cable facilities are being increasingly used by DoD armament laboratories for evaluating anti-armor submunitions. During flight tests, submu-

nitions are deployed in clusters, making individual submunition evaluation difficult. Testing techniques at Sandia enable the launch of individual submunitions into predictable flight paths that permit optimum use of instrumentation capabilities, enhancing performance evaluation. Tests

during the past year evaluated the Army Sense and Destroy Armor, XM909 Smart submunition, and the Air Force Sensor Fuzed Weapon. Another Air Force program, Chicken Little, assessed submunition effects on various armored vehicles. (7530)

Safeguards

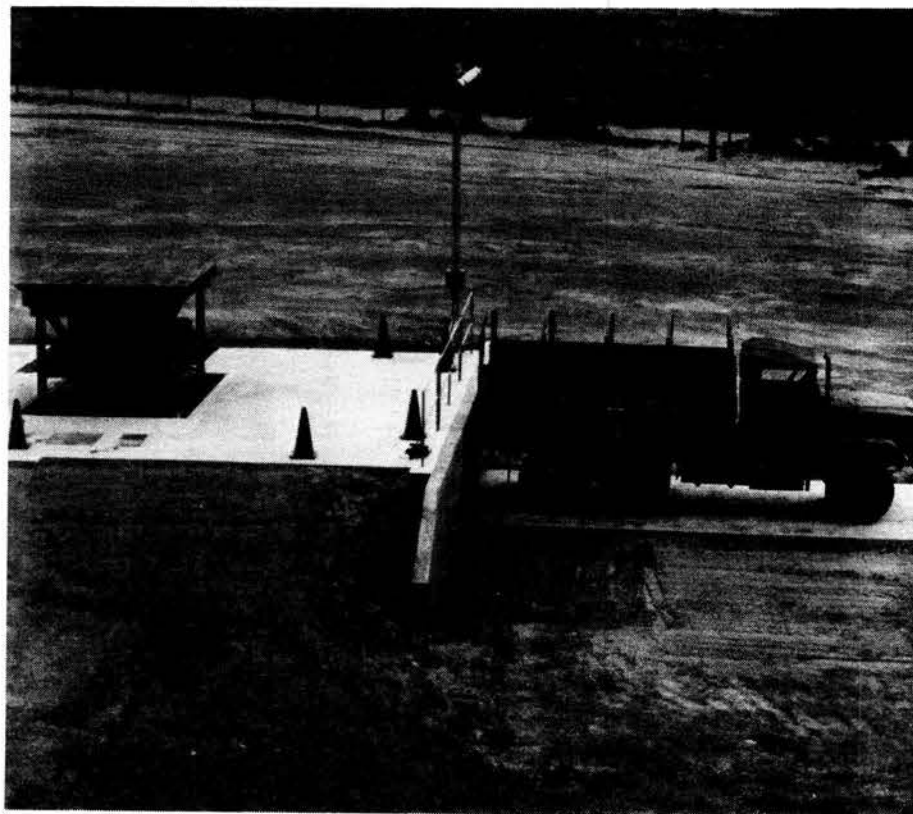
- In March, final experiments on the Fuel Assembly Identification Device (FAID) were successfully conducted at the Kahl Experimental Nuclear Power Station in the Federal Republic of Germany. The FAID is a prototypic ultrasonic seal intended as an International Safeguards measure to ensure the identity and integrity of certain reactor fuel assemblies. Twenty-four FAIDs were installed in 1983 and subjected to extended exposure in the reactor core, several for more than three years. All were successfully read and verified. This proven ultrasonic seal technology is under consideration by the Vienna-based International Atomic Energy Agency for use on plutonium-bearing Mixed Oxide Fuel Assemblies, CANDU reactor spent-fuel storage racks, spent-fuel containers, and other nuclear material containers. (5210)

- We designed and installed in Area II a prototype weapon storage vault for potential Army applications. The vault provides hardened storage for weapons, improving survivability while enhancing weapon security. The vault system incorporates integral security sensors, a microprocessor-controlled jackscrew lift system, and a central alarm display and assessment console. We started an evaluation program to investigate various loading and unloading options, and to verify security and survivability performance. These efforts are being sponsored by the Defense Nuclear Agency to allow Army evaluation of hardened storage concepts and requirements. (5250)

- We developed the nationwide dig-

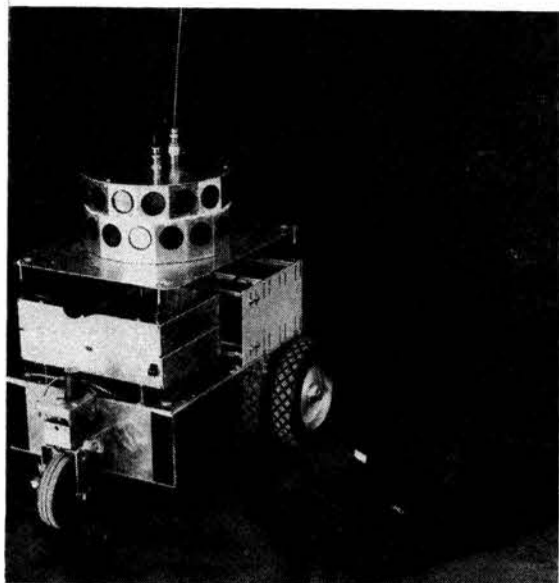
ital communications network known as SECOM (SEcurity COMmunications) to support DOE. DOE uses the system to provide command, control, and communications for its fleet of vehicles transporting nuclear material. Major enhancements installed in the system are APL (Automatic Position Location) and a new control center. APL allows the vehicle to obtain its latitude and longitude coordinates from orbiting satellites. The position and status of the vehicle is updated via sensors and an on-board microprocessor. The information is then encoded and sent to the main control center via several antenna sites that receive the transmitted message. The message is decoded, and the complete status and position of the convoy is presented to operators on high-resolution color map displays. (5210)

- The International Atomic Energy Agency (IAEA) currently uses 250 Twin Minolta Film Camera Systems for unattended optical surveillance at nuclear facilities around the world. These film cameras, which provide valuable safeguards information to IAEA inspectors, are no longer in production, and must be replaced with closed-circuit TV systems within the next five years. To satisfy this need, we developed a prototype Modular Integrated Video System (MIVS), which is currently being demonstrated to the IAEA. We designed this system to provide video scenes in an unattended, tamper-protected manner at the rate of up to 12 scenes per hour over a three-month interval, at which time the videotape must be replaced. The MIVS is being developed under a well-defined Program Plan, includ-



PROTOTYPE STORAGE VAULT, now under evaluation, was designed and installed in Area II. It is designed to provide hardened storage for weapons, thus improving weapon survivability and security.

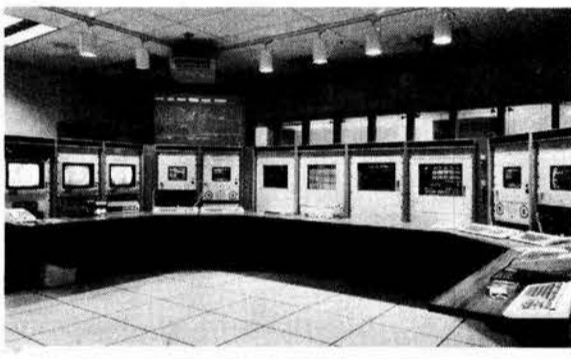
SANDIA INTERIOR ROBOT (SIR) patrols an interior area, backs up intrusion devices, and assists in alarm assessment by broadcasting a TV image to a remote station.



ing specifications and a Certification Test Plan, all of which have been approved by the IAEA. Full production of the MIVS is expected to begin in late 1987. (5210)

• We developed a three-wheeled mobile robot with the ability to perform many of the tasks normally assigned to a security officer. The Sandia Interior Robot (SIR) weighs approximately 50 lbs. and uses electric motors to drive two wheels that provide mobility in most interior environments. Sonic sensors on the vehicle allow it to determine its position and to detect and avoid obstacles; the sensors can also function as intrusion detection sensors. SIR can autonomously patrol an interior area, back up intrusion devices, and assist in alarm assessment by broadcasting a TV image to a remote station for human interpretation. (5260)

SECOM (SEcurity COMmunications) control center operator console, where encoded information on status and location of nuclear convoys is received. DOE uses the SECOM system to provide command, control, and communications for its fleet of vehicles transporting nuclear material.



Computing

• We developed an automated, interactive Product Test Data system for use by Sandia engineers in weapon development, quality, and reliability organizations. Data from test programs conducted during product development at Sandia and other test sites are integrated with data obtained from production and stockpile surveillance activities at various locations around the country. The retrieval and analysis system, called MIRACLE, provides user-friendly access for statistical analysis, graphics, digital waveform analysis, and report generation. The system is operated on a three-processor VAX cluster that is part of Sandia's Distributed Computing Network, and includes connections to integrated contractors and test sites. (2820)

• DOE's Computer Integrated Manufacturing (CIM) Program, within which SNLA serves as the lead laboratory, achieved a significant milestone with the successful completion of the Trident II (T-II) CIM Review. During the review, the ability of each site within the Nuclear Weapons Complex (NWC) to create and maintain T-II drawings in digital formats as computer-aided design files was confirmed. In addition, and more important-

• We developed a new computer program to model and evaluate safeguards systems. This user-friendly code runs on a personal computer and is called SAVI (Systematic Analysis of Vulnerability to Intrusion). The primary results are a calculation to determine if the response force will intercept an adversary before the sabotage or theft mission is completed. SAVI also identifies the vulnerable paths into and out of a fixed-site nuclear facility. With SAVI, the effectiveness of proposed security upgrades is easily analyzed before funds are committed. This method has so far been taught to 140 DOE Field Office and Operating Contractor security personnel as part of the Tactical Vulnerability Assessment Training Program presented at the DOE Central Training Academy. (5210)

ly, each site demonstrated the ability to exchange two-dimensional mechanical drawing files in digital form with other NWC sites using the SNLA-conceived DOE Data Exchange Format. (2810)

• We initiated the *Sandia Software Guidelines*, a series of volumes on software quality, documentation, configuration management, tools, techniques, and methodologies. The series provides guidelines for Sandians to achieve the objectives of software quality engineering. The first of the *Guidelines*, entitled "Standards, Practices, and Conventions," was published in July and is now in its fourth printing. Each volume is written by a small working group and approved by a balloting group of more than 50 Sandians from throughout the Labs. Currently, the volume on "Software Quality" is being reviewed by its balloting group. (2810)

• During the past year, the Cray Time-Sharing System (CTSS) was installed as the operating system for the Cray X-MP/24, and a new supercomputer, a Cray X-MP/416, which will also run CTSS, was acquired. The new computer is the most powerful computer now com-

mercially available. The increasing complexity of modern weapon systems and the need to design them as cost-effectively as possible continue to require increases in the quality and quantity of analyses of the designs. This new computer gives us the capacity and capability to meet our near-term weapon-design computing requirements. (2640)

• We evaluated and placed into production a hardware-based computer security system. This system combines the

usual user name/password with information provided by a unique, optically coupled electronic circuit assigned to each user of the system. Overall computer security is enhanced because physical evidence, much like the output of a badge reader but more difficult to counterfeit, is also considered before access to the computer network is granted. Each circuit can be programmed to operate indefinitely or expire after a predetermined date or number of uses. (8230)

Miscellaneous

• The *TRansUranic PACkage* Transporter (TRUPACT-I) successfully completed regulatory accident-testing. A major containment subsystem for radioactive particulates, the Filtered Pressure Equalization System, was defined and tested sufficiently to establish the feasibility of using it in both normal and accident transportation environments. We completed and submitted a Safety Analysis Report for Packaging to DOE for certification. We tested a prototype unit to simulate normal transportation conditions such as highway-induced shock and vibration and changes in temperature and atmospheric pressure. Operational experience for DOE user sites was provided to establish procedures for handling and loading and unloading of future shipments of contact-handled transuranic waste. There are two production TRUPACT-I units available for DOE use when certification is completed. (6320)

• We undertook a project that involves specialized image processing — specifically, the automatic recognition of vehicles passing through a scene. During field tests, a "smart" imager has been very successful in recognizing "vans" and "pick-ups," the two classes in its knowledge base. The computing required to make the call takes approximately 30 seconds. Upgrades to the computing hardware will reduce the time to about three seconds. (9110)

• We developed a new gas-leak calibration facility based on fundamental principles that are different from those currently in use. Compared to present systems, the new system calibrates leaks in less than half the time and with a lower measurement uncertainty, thereby providing more meaningful comparisons with national standards. The instrument determines the leak rate of standards from 10^{-6} moles/sec. to 10^{-11} moles/sec., thus covering a range of five orders of magnitude in leak rate. The standard leaks are used to calibrate the operation of leak

detectors, residual gas analyzers, and mass spectrometers used throughout the DOE weapons complex. (7240)

• We used Artificial Intelligence (AI) and expert systems in two related projects. Typically, expert systems are used to replace or assist a human performing a task. In a system study of roadside vehicle detectors, an expert system was used to simulate the human decision making involved. This is a unique contribution that expands the applicable domain of systems analysis. Next, a fieldable version of the software for the expert system was also written in PASCAL — not a traditional AI language. This software runs on many personal computers. The expert system helps an operator interpret data from complex networks of vehicle detectors. (9110)

• We developed the Beneficial Uses Shipping System (BUSS) cask in support of DOE's effort to encourage use of by-product isotopes resulting from the production of plutonium for national security needs. We used state-of-the-art structural and thermal computer analysis techniques to design the cask. A full-scale, stainless steel prototype cask and ancillary handling equipment were fabricated and assembled for operational tests, and the Safety Analysis Report was published. The cask will transport irradiation source capsules of cesium chloride or strontium fluoride from the Waste Encapsulation and Storage Facility at Hanford, Wash., to licensed commercial food- and pharmaceutical-irradiating facilities. (6320)

• We developed a new computer vision algorithm for video motion detection. By looking for purposeful motion along known paths in the video image, the algorithm detects and tracks multiple objects. We successfully demonstrated this technique on realistic battlefield data; it will prove useful for surveillance and monitoring of both battlefield and secured areas. (9130)

Guide to this Issue

This LAB NEWS is actually three issues in one — peel off the outside eight pages and you have the complete Technical Accomplishments 1986 special section. The next 12-page section is your standard LAB NEWS. The inside pages are the annual "State of the Labs" issue, featuring President Irwin Welber and Executive VPs Orval Jones and Lee Bray.



Benefits Package Touches Everyone

We don't see it as dollars on the pay stub, but most Sandians recognize that the dollars' complimentary complement, collectively known as the benefits package, is worth a great deal. The package, paid for mostly by Sandia, "competes very well with those offered by other companies," says Charles Mika, manager of Benefits Department 3540. "And it has a substantial impact on everybody."

In an effort to nail down some specifics on the Labs' benefits package — where we are now, where we plan to go — LAB NEWS recently interviewed Charles, along with Ralph Bonner, Director of Personnel 3500. Following are excerpts:

SLN: Our benefits package covers many different programs. What would you say are the major elements?

RCB: Sandia's retirement plans, including savings plans and Social Security as well as pension plans, have to be close to the top of the list. Other items that are of significant value to employees are vacation, health care, holidays, and life insurance.

SLN: Which of these programs costs the most? And what is the overall cost to Sandia?

RCB: In FY 86, Sandia's share of retirement package costs totaled \$38.6 million. Of that amount, Social Security payments totaled \$21.6 million, savings plan contributions \$9.1 million, and pension

Dollar cost is important, but even more so is what we call "value" to employees.

plans contributions \$7.9 million. Vacations cost \$28.7 million and health care plans cost \$25 million. Overall, fiscal year costs were \$112.3 million.

Dollar cost is important, but even more so is what we call "value" to employees. We could spend a lot in one area, but if that area doesn't affect a large number of employees, it's not of much value to the majority. Take, for example, the LTD [Long Term

(Continued on Page Four)



RALPH BONNER (3500, left) and Charles Mika (3540) discussed Sandia's benefits package during a recent LAB NEWS interview. Here, they look over booklets that describe, in detail, various parts of the package.



LAB NEWS

VOL. 39, NO. 3 SANDIA NATIONAL LABORATORIES FEBRUARY 13, 1987

Administrative Accomplishments 86

Enhancing Employee Excellence and Efficiency

Sandia's responsibilities, reputation, and *raison d'être* are reflected in its technical accomplishments, as evidenced in the crop of Tech Accomps 86 in a special section of this issue.

But one of the primary reasons Sandia performs its technical tasks well is that it performs them efficiently; another is that it has attracted and retained an excellent technical staff. "Neither that efficiency nor that excellence could be achieved, year in and year out, without some solid accomplishments by the administrative organizations," notes Administration VP Art Davie (3000).

"As President Welber expressed it in last year's 'State of the Labs' message, 'At Sandia, administration is a member of the team,' says Technical Support VP Bob Peurifoy (7000). "A strong administrative arm not only helps Sandia do its job better but helps our customers get more benefit for their bucks. And I may be a bit biased, but I'm really proud of the good work done by our administrative groups, for example, the plant engineers in 7800 — they work with the technical organizations to ensure that Sandia's new buildings and modifications to old buildings can provide the state-of-the-art capabilities needed to develop new technologies."

"Collectively, the administrative organizations in 100, 3000, 7000, and 8000 have made some significant progress in the past year or two," says Art. "And that progress will continue, sped along by the strategic planning that's now well under way."

"The value of such planning is that it forces us to look down the road — to decide who we want to be, where we want to be, and where our customers

inside and outside the Labs want us to be," Art continues. "Less figuratively, it helps us decide how best to use our resources in accomplishing our tasks."

Art and Bob reviewed the 50 administrative accomplishments for 1986 submitted by line organizations. Those still in the design or planning stages were postponed until next year. Here are the (randomly ordered) administrative accomplishments for 1986:

- A high-pressure liquid nitrogen pumping system for a wind tunnel was designed and constructed for Experimental Aerodynamics Division 1554. This system compresses liquid nitrogen from the bulk storage tank pressure of 120 psi (pounds/square inch) to 11,000 psi, a unique capability. Liquid is converted to gas in an ambient air vaporizer with final temperature adjustments by an electric heater. Compressed gas is accumulated in an array of cylinders. Blowdown from the cylinders creates a wind tunnel speed of Mach 14. The pumping cycle is controlled by a microprocessor that continuously monitors pump discharge temperature and pressure and automatically shuts down if it detects anomalous conditions. System capacity permits the recharge of cylinders from 4000 psi to 10,000 psi in 30 minutes. (7840)

- McAL (Maintenance contracts at Livermore), a program to control and closely monitor maintenance contracts, has recently been designed and implemented by the purchasing organization at Livermore. McAL has helped to eliminate paying for maintenance of equipment that is no longer being used, for preventive maintenance that was not performed, for discrepancies that resulted in modifications and/or

cancellations, and in general, for optimizing our negotiating powers by combining requirements. This cost avoidance is estimated to be approximately \$300,000 per year. (8264)

- "Zebra-striped" identification labels (bar codes) have been applied to approximately 120,000 pieces of property over the past year. The labels reflect Property Management Services' new method of identifying, controlling, inputting, and reporting on controlled property. The new method should allow

(Continued on Page Six)

'State of the Budget'

Discussed Earlier, More to Come

This special issue of the LAB NEWS has traditionally included a discussion of the current fiscal year budget with Paul Stanford (100) and other members of his organization. This year, however, that subject was discussed in our Nov. 7, 1986, issue.

"Congress is currently working out the details of the FY88 budget," says Paul. "so it's too early to say any more than we said in November. When that work is finished, we'll work with LAB NEWS on an article that will be based on fact, not on the conjectures we'd have to resort to if we published an article now."

Antojitos

State of the Labs, Tech Accomps, and All the Rest Yes, it's another of those "too big to read today" issues; take it home (and there goes the weekend!). We thank the many Sandians who helped: all the people in the line organizations who submitted accomplishments, technical or administrative -- whether or not they were selected for inclusion in this issue; and all the reviewers, up through VPs plus Arlyn Blackwell (400), Charlie Winter (ret.), and Classification. On the "State of the Labs" side, we thank Irwin Welber, Orval Jones, and Lee Bray, without whose willingness to share insights we'd have no story. And again we thank Classification and the other Sandians who reviewed the final version -- including President Welber, who probably didn't get much else accomplished the weekend of Feb. 7-8. We thank Ralph Bonner (3500) and Charles Mika (3540) for their help with our story on the Benefits package. And, finally, we thank Bob Park and Larry Greher (both 4010) for quick responses during a frantic week in their offices and ours.

* * *

We Note with Sadness the recent deaths of three people who left their mark on Sandia. Former president John Hornbeck (1966-72) died Jan. 30 in Savannah, Ga. Lou Paddison, who held five directorate positions at the Labs from 1947 until he retired in 1974, died Feb. 4. And Howie Mauldin (DMTS, 2566) died Dec. 2 after 37 years with the Labs. An excerpt from Tom Cutchen's (2560) eulogy for Howie: "He created, almost single-handedly, a new technology in the field of high-performance and high-energy-density storage capacitors [see LAB NEWS, Oct. 10, 1986]. His death has left a void that may never be filled and a legacy that can never be forgotten."

* * *

The Verbal Doubletake "Hey, what did that say?" Front page headline, 48-point type, in LLNL's newspaper: "Lab to House Dating Center." Sure wish they'd had one when I was in Livermore, and single. (Turns out it's an accelerator mass spectrometer that will determine the age of artifacts and geological substances -- and Sandia's Physical Science Department 8340 is one of the "partners" in the \$5 million project.) Our current phonebook lists Lisa Rogers (3533) as Personnel's "Recetionist." Sounds political to me. The same phonebook shows Nancy Barela and Sandra Harris (both 3437) in charge of "Outgoing Visits" for the Badge Office. You don't get much time to justify your next visit, I guess. Finally, from 2600's computer newsletter: "Two people called in violent opposition to our deleting this [Port Contender Stats] section. A number of other people called specifically to say they were glad we did away with them." Moral: Don't violently oppose 2600!

* * *

Murphy's Law of Recovery: If you lose something, it won't be found till after you've replaced it. The validity of that statement was not clear to Tanya McMullen (2634) until recently. During the Jan. 16 storm, the wind extricated her badge from her grasp and blew it away. Ten days later, minutes after she got a permanent replacement badge, she received a call from a woman who had found the missing badge lodged under a parking bumper. ●BH

* * *

If you do find something you've lost, it will always be in the last place you look.



Here are a few current volunteer opportunities for employees, retirees, and family members. If you would like more information, call Karen Shane (3163) on 4-3268.

SCIENCE FAIR JUDGES are needed throughout the area schools. A-269 time may be charged for judging. Judges are needed at the following schools:
SOUTHEASTERN NEW MEXICO SCIENCE AND ENGINEERING FAIR, New Mexico Military Institute, Roswell, Saturday, February 28, 10 a.m.-2 p.m.;

NORTHEASTERN NEW MEXICO REGIONAL SCIENCE AND ENGINEERING FAIR, New Mexico Highlands University, Las Vegas, Saturday, March 21;

ST. CHARLES BORROMEIO SCHOOL (grades 6-8), 1801 Hazeldine SE, Wednesday, February 25, 12-3 p.m.;

SUNSET MESA SCHOOL (grades 1-8), 3030 Morris NE, Tuesday and Wednesday, February 24 and 25, 9-11:30 a.m. and 1-3 p.m. both days.

IDENTI-FIND-A-CHILD is a non-profit program that provides fingerprinting, dental identification, educational, and outreach awareness to children, parents, teachers, and communities throughout New Mexico. Since its founding four years ago, recognition for the program has been received from President Reagan and the National Volunteer Action Center as well as from local officials. A volunteer is needed to help with PR aspects of the program: to refine and simplify written material, to produce a brochure, to assist with grant writing, etc.

BIG BROTHERS/BIG SISTERS OF ALBUQUERQUE is a United Way agency that recruits and trains adult volunteers to be matched with single-parent youngsters to explore friendship and mutual interests on a one-to-one basis. BB/BS is sponsoring a Bowl-a-Thon fundraiser on March 29 and would like a volunteer to serve on an advisory committee for the event.

LAB NEWS

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AS PRESIDENT WELBER NOTES in the "State of the Labs" interview, he spent four months working closely with his predecessor, George Dacey. During that transition period, it wasn't easy finding a private place to discuss the secrets of high technology -- or low. Which one's which? If you have to ask, the answer doesn't matter. (Thanks to Christina Ross, wife of Ian Ross, President of Bell Labs, for taking the photo, and to President Welber for sharing it with us.)

New Book on Scientific Writing Has to be Interesting

For the past four years, Michael Alley (8265), a technical writer and electrical engineer, has tried to figure out the real reasons that most scientific writing is weak. Out of his research, he has (on his own time) written a book to help scientists and engineers strengthen their writing. The book, *The Craft of Scientific Writing*, has just been published by Prentice-Hall and is now available in hardback.

According to Michael, the book has two main goals: first, to address the real problems that scientists and engineers face when they sit down to write; and second, to be interesting enough that scientists and engineers will read it.

Michael actually began the book during graduate school at the University of Alabama, where he was asked to teach technical writing to undergraduate engineers. Although he had an MS in electrical engineering from Texas Tech University, he had decided to try his hand at writing fiction. "When I came to Alabama, I thought my work in science and engineering was over," he says, "but in fact it had just changed perspective."

Unable to find a suitable technical writing text, Michael began teaching from his own notes. "I read a lot of textbooks," he says, "but with each one I came to the same conclusion — hey, this isn't the way it is. The examples were outdated. The language and illustrations were too simplistic. And no one cut to the heart of the matter about why most scientific writing is weak."

In 1984, with a draft of the book in hand, Michael came to Sandia Livermore as a technical writer. However, at Sandia he changed much of his thinking about scientific writing. "I had some interesting ideas about style," Michael says, "but working them into actual papers and reports made me reconsider my thinking. I learned a lot from working on the papers and reports of staff members, people such as Lee Radosovich [8133] and Jill Hruby [8441]. I also learned a lot from the writers then, Pat Smith and Bob Tucker [both 8265]. Being at Sandia made me reconsider some ideas and sharpen others."

Michael put the Alabama draft aside and in two years completely rewrote the book. He anchored his ideas with examples, many of which Sandians will recognize — examples from research in solar energy, combustion, and particle beam fusion. "There's a lot of good writing produced here," he says. "I took advantage of that whenever I could."

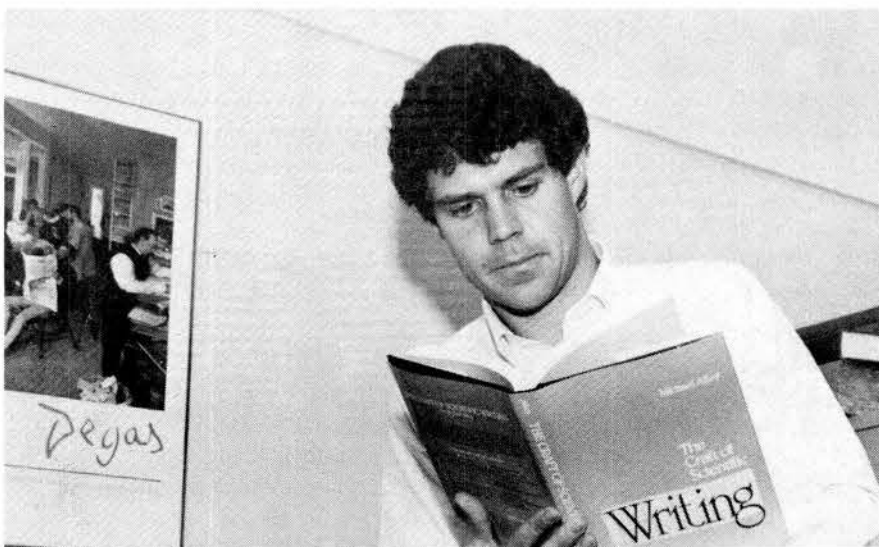
In his revised draft, Michael also added a section that deals with the problem of actually sitting down to write. The section discusses how to get into the mood, how to write first drafts, and how to revise. It includes such topics as writing under deadlines, accepting criticism, and choosing among pencils, pens, and word processors.

Michael says, "The heart of the book comes down to the question about why most scientific writing is weak. The principal reason is not that scientists can't write. It is weak because scientists don't know what strong writing is." His book presents 25 common misconceptions that scientists have about writing, then uses numerous examples to show scientists the differences between strong and weak writing.

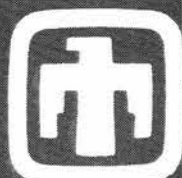
The Craft of Scientific Writing is not the only book that Michael plans to write. He's finishing a collection of short stories and preparing groundwork for a novel. Most of his fiction is set in the Southwest. He's also been approached about publishing a sequel to his book on scientific writing, one on scientific speaking.

Each quarter at Sandia Livermore, Michael teaches a scientific writing class to staff members, and on his own time he directs a fiction-writing workshop under the auspices of the Livermore Area Recreation and Park District.

Those interested in obtaining his new book will find it at B. Dalton bookstores in the Valley and in Albuquerque, as well as at Goodenough Books in Livermore.



NEW AUTHOR Michael Alley (8265) with a copy of his book.

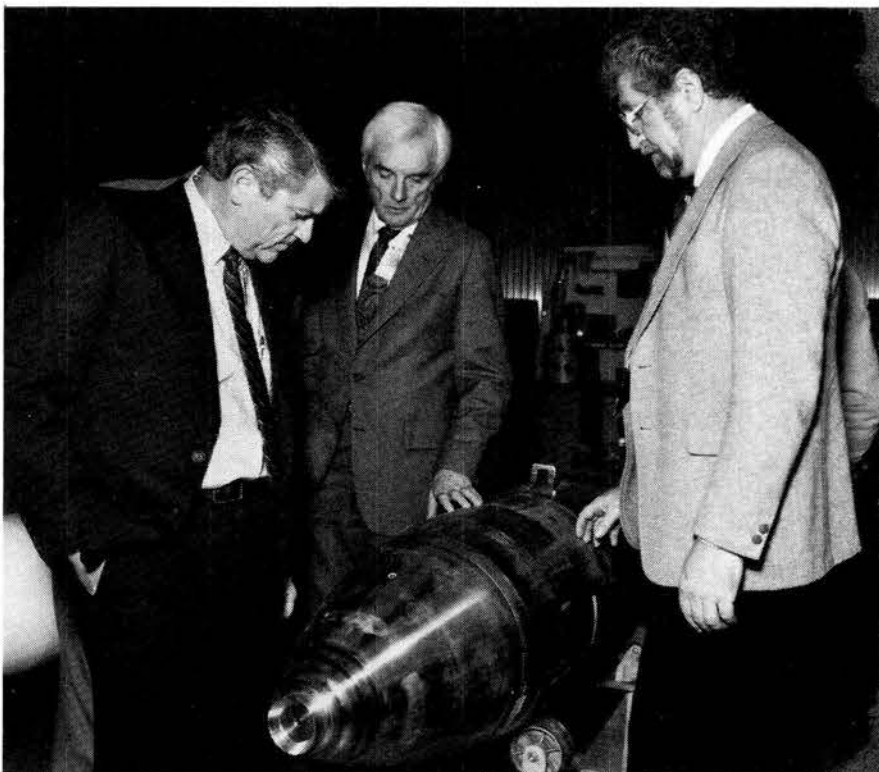


SANDIA LIVERMORE NEWS

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EXAMINING A B83 test unit during a recent tour of Sandia Livermore is Tom Thomsen (left), President of AT&T Technology Systems, Sandia's parent company. With him are Sandia Livermore VP Dick Claassen (8000) and Gene Ives (right), Director of Weapon Development 8100. The AT&T official (and Sandia Board of Directors member) was also briefed on optical image processing, chemical kinetics and pyrogenic materials, the SCABBARD code, RAPRENOx, welding technology, computer modeling, and SDI activities.



NEW HIRE SECRETARIES who completed Sandia Livermore's first Secretarial Training Program received certificates from Pete Dean (right), supervisor of Education Division 8024, and Lorena Schneider (8023, left foreground), who developed the program. Most of the participating employees are fully qualified secretaries when they come on roll, but the program provides supplemental training in Sandia's unique requirements and way of doing business, with classroom instruction presented by specialists from various line organizations. The trainees (from left): Irene Mulry, Evelyn Chaney, Cherie Cuthbertson, Pat Brennan, Debra Randich, Betty Fredlund, Carol Knapp, and Linda Lucchetti; another trainee, Karen Cafaro, is not shown. Standing in background is Tonni Nunley, section supervisor in Personnel Division 8022.

Benefits: The Hidden Paycheck

Disability] plan. We're thankful that only a few people have to use it annually. In fact, the total number of people receiving LTD benefits is only 50 or 60. But if we provided additional LTD benefits and cut back in other areas that touch everyone — health care for instance — the overall package would be less valuable. Our aim is to come up with the best possible mix of programs — the most valuable combination for the majority of Sandia employees.

SLN: Benefits are often called "the hidden paycheck." On average, what percent of salary does the benefits package equal for a typical Sandia employee?

RCB: When all costs are considered — everything from retirement plans to unemployment taxes — benefits costs have ranged from 35 to 43 percent of gross payroll during the last 10 years. In FY 86, the number was 35 percent.

SLN: What do we do to ensure that Sandia's benefits package stays competitive with those at other companies? Who has that responsibility?

CMM: We participate in several annual benefit surveys, and receive additional market analyses from other sources. The fact that our benefits package closely parallels that of AT&T, which also has independent consultants perform annual benefit surveys of comparable companies, provides another evaluation

Small Staff keeps an eye on overall costs.

of our package's competitiveness. The line organization, from Benefits Department 3540 through Lee Bray [30], has responsibility for detailed analyses and benefits planning in areas such as the pension plan, group life insurance, and health care. Small Staff keeps an eye on overall costs. The main objective is to maintain an affordable benefits package that attracts and retains good employees.

SLN: Are all parts of Sandia's benefits package based on an AT&T model or AT&T policy? Or are there some programs that are unique to the Labs?

CMM: For the most part, our program is similar to that of AT&T. However, DOE's contract with AT&T allows departures from AT&T practice if local conditions warrant them. Our vacation plan comes readily to mind; the 24-day-a-year allowance is a carryover from the time when Sandia was managed by the University of California. We continued the plan because AEC [now DOE] recommended its continuation. In contrast, length of service determines vacation allowances for AT&T employees; however, they get a set number of personal-absence days per year, so that brings our programs closer together.

Sandia's health care plan differs slightly from that of AT&T, but it provides the same overall level of protection against financial loss from serious medical problems. And there are other minor differences in various benefit plan funding and pension plan administration.

SLN: What significant changes have occurred in the benefits package during the last year or so?

RCB: Two years ago [January 1985] retirees in both the Pension Security Plan [PSP] and the Retirement Income Plan [RIP] received special increases, the amount dependent on how long they'd been retired. Also, the PSP monthly benefit table was improved twice — in October 1985 and October 1986. The base period used in the pension formula for RIP participants was moved at the end of August 1985 to more favorably reflect current salaries. And employees enrolled in SPSE [Savings Plan for Salaried Employees] received a pre-tax, or 401(k), savings option last April; about 60 percent of those eligible initially took the pre-tax option.

SLN: Anything new on the horizon for 1987?

RCB: Two changes are already in place, as of January 1. The annual maximum allowance for the dental plan increased to \$1000 from \$750. And, because of a Federal legislative change, certain persons who have lost health care coverage may now purchase, at group rates, coverage for periods rang-

ing from 18 to 36 months. This change offers individually-paid temporary health care coverage at Sandia's group rates to divorced spouses, dependents no longer covered because of age, or employees who leave Sandia without continuing company-paid cov-

Another change will introduce a 401(k) option next July for participants in the SSP.

erage. In other words, people who find themselves suddenly without coverage now have a way to tide themselves over. Another change will introduce a 401(k) option next July for participants in the SSP [Savings and Security Plan].

SLN: Who approves changes in the benefits program?

RCB: Most plan changes must be approved by Sandia management and the Board of Directors. In addition, President Welber has authority to make changes necessary to keep our plans in compliance with federal or state law. A recent example is a law passed by Congress eliminating mandatory retirement at age 70; our pension plans now reflect that change. Pension plan changes must also be approved by DOE and the IRS.

SLN: Talking specifics, now; here's a question lots of employees would like to have answered. How well funded are Sandia's pension plans? Currently, what's the fund total, and what percentage increase did it experience last year?

RCB: The adequacy of contributions to and size of the pension funds are determined by the plans' enrolled actuary — a person who, on behalf of all plan participants, has certain responsibilities as set forth by ERISA [Employee Retirement Income Security Act]. These responsibilities include certifying the reasonableness of assumptions and the actuarial valuation of fund assets.

The funding and investment policies of the pension plans reflect the long-term nature of retirement liabilities. The objective is to fund, over the working lifetimes of employees, for projected retirement benefits based on salaries or pension band values and future service. Given this long-term orientation, an upwardly explosive stock market, such as the one we've observed since the beginning of the year, is not immediately presumed to be available to finance new benefits for the long term. With this prudent approach, which results in level funding, we know that we'll have assets to cover our obligations through the lean years as well as the good ones.

The fund totaled about \$1,040,000,000 at the end of December. In 1986, assets increased 10.3 percent.

SLN: Recent news indicates a strain on the Pension Benefit Guaranty Corporation — the federal agency that insures corporate pensions of more than 30 million workers and retirees. The strain was caused by PBGC's bail-out of a large company's pension plan when that company declared bankruptcy. Does this situation affect Sandia's pension plan in any way?

CMM: Bankruptcy itself doesn't cause a strain on the PBGC, provided the company's pension plan is not underfunded. For plans like ours that are well funded, there is no direct effect. Adequate plan funds are our best protection, and Sandia shouldn't require a bail-out from PBGC because we are well funded. Nevertheless, Sandia, like almost all companies with qualified private pension plans, pays annual PBGC premiums based on the number of plan participants — an "insurance policy," so to speak. The annual assessment per participant [current retirees and on-roll

Our retirees are an important and growing population . . .

employees] was \$8.50 last year, up substantially from the fee in 1974, when it was \$1 per participant. There's some speculation that the PBGC fee may again be increased by Congress to an amount between \$25 and \$42 [per participant].

SLN: Currently, how many retirees do we have?

Any projections for what that number will be five years from now?

CMM: We now have 3155 retirees and 517 survivors who draw benefits. Though projections are difficult, 4000 retirees and between 750 and 1000 survivors are not improbable five years down the road. Our retirees are an important and growing population, with an increasing impact on our benefits program. A definite advantage for Sandia retirees is the continuation of company-paid benefits coverage in a number of key areas: medical care, dental, life insurance. Medical care continuation is seen as increasingly valuable by retirees.

SLN: Are there any plans to increase pensions for retirees?

RCB: Our goal is to provide retirees with financial security through a number of sources, not just the pension payment. Social Security, savings plans, and continuing benefits coverage are all part of the picture. We have made adjustments along the way for retirees when the need was clearly demonstrated.

SLN: In 1985, the RIP base period was stretched to seven and a half years. Any chance that it (1) will soon revert to five years, and (2) will be moved forward to better reflect current pay?

RCB: When Sandia adopted the AT&T plan design in 1980, the basic formula percentage multiplier was improved, from approximately 1.4 to 1.6 percent. The "stretch" in 1985 resulted in improved pensions. Since our plan is patterned after that of AT&T, the answer to your first question is: Prob-

. . . the increase [for medical costs] for the last five years, beginning in 1982, was 140 percent.

bly not, unless AT&T moves in that direction. Chances are that the base period will ultimately be moved forward to keep our plan competitive, but I can't speculate when that might happen.

SLN: Medical costs have skyrocketed in recent years. What kind of cost increases has Sandia experienced? What factors contribute to increased medical costs?

CMM: In the last three years [1984-1986], we saw an overall increase of 40 percent. More significantly, perhaps, the increase for the last five years, beginning in 1982, was 140 percent. That latter figure reflects a massive increase in the medical CPI [Consumer Price Index] for the 1982-83 time frame. Looking at last year, the increase in the 1986 medical CPI was 8.0 percent, compared to the overall CPI increase of 1.1 percent. What this says is that costs for medical services have been increasing at a substantially higher rate than have costs for other goods and services. For Sandia, the increased costs reflect a combination of two or three major items: rising hospital/surgical expenses; a growing number of active employees and retirees; and plan improvements in 1983 (for example, 90 percent coverage on hospital/surgical costs with no deductibility requirement, which brought the plan more in line with AT&T's).

SLN: The Tax Reform Act of 1986 allows employees to save up to \$7000 per year in tax-deferred 401(k) plans. Sandia employees are now allowed to set aside a maximum of 10 percent of salaries for the 401(k). For a lot of us, 10 percent doesn't equal \$7000. Any chance of getting that maximum contribution raised to \$7000?

RCB: AT&T, which sponsors the savings plans, is not planning to increase the current maximum pre-tax deferral rate or to replace it with \$7000.

SLN: Company contributions to our benefits package are not currently taxed. An exception: The value of group insurance coverage in excess of \$50,000 is considered taxable income. Do you foresee taxation of other parts of the benefits package — if so, which ones?

RCB: Early proposals for tax reform in 1985 contained provisions to consider some or all of the cost of certain employer-provided benefits as tax-

Benefits

ble. Among those were health care and educational assistance. As long as deficit reduction and tax reform continue to be high Congressional priorities, there is always the possibility of heretofore untaxed benefits becoming taxable.

SLN: New hires currently may not enroll in some of Sandia's benefit plans until they have been on roll six months. Any plans to change at least a few of these to "instant coverage" once a person is on roll?

RCB: No. However, let me point out that Sandia covers new hires in our medical plans from day one, while AT&T does not cover them for the first six months. (AT&T new hires are given the option of buying coverage for themselves at group rates during that six-month period.) For dental and vision plan benefits, Sandia, like AT&T, requires new employees to wait six months.

SLN: Just for historical perspective, what parts of the benefits package were in place when Sandia was established in the late 40s?

RCB: The package was pretty slim back in those days. It included a retirement plan — the University of California plan until a Sandia pension plan was established in June 1950; hospitalization coverage (group rates were available, but it was employee-paid); a vacation plan — the same one in place today; a sickness absence plan, patterned after that of the University of California; and workers' compensation. It

The package was pretty slim back in those days.

was a far cry from today's package, which contains a much larger number of plans — the majority of which are paid for entirely by Sandia.

SLN: On a couple of programs at least — the pension plan and health care — employees at one time or another contributed a portion of the cost. When did this change?

CMM: The retirement plan became noncontributory in July 1975. The First Supplemental life insurance program was paid for by participants — not the Labs — until 1970. In the early days, even Basic life insurance was not provided until an employee had been with the Labs for two years. The Long Term Disability plan was paid for by Sandia beginning in 1979, and the basic medical plan, with coverage for employees and dependents, was fully company-paid starting in 1970. It goes without saying that monthly medical care premiums increased significantly between 1970 and 1987 — from \$11 to \$80 for single coverage, and from \$17 to \$214 for family coverage.

SLN: One new trend in company benefit programs seems to be the "cafeteria" approach — letting employees pick and choose which parts of their overall benefits program are most appropriate for them — up to certain limits on coverage, of course. Has Sandia considered such a plan?

CMM: Depending on what survey you're looking at, between 15 and 25 percent of large corporations have "flexible benefit plans." These plans are used both to control the total cost for benefits and to meet different needs of a diverse group of employees. We already have some flex features: dependent group life insurance, voluntary group accident insurance, Second Supplemental life insurance, and the

... we may see cafeteria options in the future, though probably not in the near term.

401(k) savings option. Sandia has not yet considered a plan that would affect all elements in our package; a primary reason is that it would be a significant departure from AT&T policy. However, the trend is there and we may see cafeteria options in the future, though probably not in the near term.

SLN: Do we see changes down the road — say, in 1990 and beyond — that will make Sandia's benefits package look different?

RCB: It's a "given" that medical care costs will continue to receive great attention because of their magnitude and the projection that increased costs will continue. Sandia and many other companies are evaluating cost-containment features that will, at the same time, help protect medical plan participants. Among these features are precertification review for non-emergency admission to a hospital; you or your doctor tell the plan administrator why you're going to enter the hospital, and the administrator reviews the circumstances. Another thing under evaluation is requiring a second doctor's opinion before certain non-emergency surgery.

Our focus will be on maintaining what we think now is a very good benefits package. In the last several years, Congress has increasingly legislated changes in benefit programs, and almost all of these changes are costly to employers; that trend is likely to continue, and we'll pay very close attention to the effects of legislation on our program. Our policy is to maintain a set of individual benefit plans that, in combination, create a competitive package — competitive in the sense that we can attract and retain a strong staff. Right now we compare favorably with other companies, and we want to keep that status. ●PW

Events Calendar

Feb. 13-July 31 — Exhibit, "Maya: The Image from the Western World"; 9 a.m.-4 p.m. Mon.-Fri., 10 a.m.-4 p.m. Sat.; main gallery, Maxwell Museum of Anthropology, 277-4404.

Feb. 13-15 — New Mexico Repertory Theatre's production of "The Taming of the Shrew," 8 p.m. (2 p.m. Sun.), KiMo Theatre, 243-4500.

Feb. 13-March 1 — "Today's Maya," an exhibition of photos by Jose Kuri Brana; 8 a.m.-5 p.m., KiMo Gallery, 848-1370.

Feb. 13 — On Broadway at South Broadway Series: "Grandma Slid Down the Mountain," with entertainer Cathy Fink; folk songs, humorous stories, and yodeling lessons; 10 a.m. and 1 p.m., South Broadway Cultural Center, 848-1374.

Feb. 13-14 — Concert, New Mexico Symphony Orchestra conducted by Neal Stulberg, featuring "The Enchanted Lake" by Liadov; Concerto for Clarinet in A Major, K.622 by Mozart; and "Enigma" Variations, Op. 36 by Elgar; 8:15 p.m., Popejoy Hall, 842-8565.

Feb. 13-23 — Exhibit: pottery figurines by Dorothy Trujillo and family of Cochiti Pueblo; 9 a.m.-5:30 p.m. Mon.-Sat., Indian Pueblo Cultural Center, (gallery), 843-7270.

Feb. 13-March 15 — "As Is," story by William Hoffman about a young man dying of AIDS; 8 p.m., Vortex Theatre (Central & Buena Vista), 247-8600.

Feb. 13-March 29 — Exhibit, "Flat Roofs and Pointed Arches: John Gaw Meem and the Architecture of Tradition"; upper gallery, UNM Art Museum (gallery talk on this exhibit by Christopher Mead, 5:30 p.m., Feb. 25), 277-4001.

Feb. 13-15, 20-22 — "Beauty and the Beast," mystical tale for ages 8 and up; 1 & 7 p.m., UNM Continuing Education Center, 277-3751.

Feb. 14 — Mayor's Charity Ball, 6 p.m.-midnight, Albuquerque Convention Center, 768-4575 or 768-3000.

Feb. 14-16 — Friends and Lovers Valentine Balloon Rally, southwest of Rio Rancho, 884-1944 or 293-6800.

Feb. 14-March 29 — Exhibit, "Drawing: Six Approaches," a look at drawings by six New Mexico contemporary artists; opening reception, 5-7 p.m., Feb. 13; gallery talk by Mary Sundstrom, 3:30 p.m., Feb. 24; Jonson Gallery, 277-4967.

Feb. 15 — "Animals Nobody Likes," a program on bats, bugs, spiders, and snakes; features talks, tours, games, and hands-on activities for kids of all ages; 1-3 p.m., Rio Grande Zoo, 843-7413.

Feb. 15-March 1 — Film Festival About the Arts: fiction films about painting, theatre, dance, music, and opera; 3 p.m. Sundays, Rodey Theatre, 277-7312.

Feb. 17 — 36th Annual Miss USA Pageant, 7 p.m., Tingley Coliseum, 243-3696.

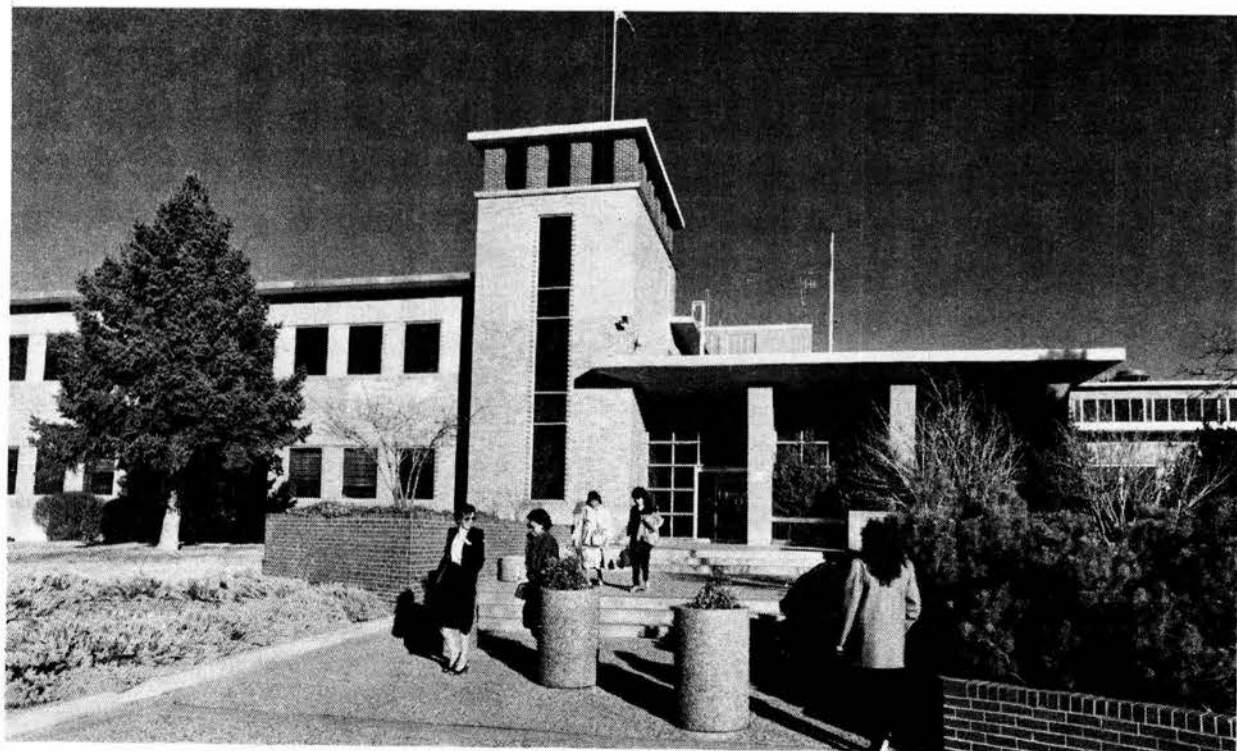
Feb. 17-March 29 — Exhibit: Focus on Faculty series, new work by Basia Irland, UNM associate professor of sculpture; west gallery, UNM Art Museum, 277-4001.

Feb. 18 — Mexican National Dance Company, 8 p.m.-midnight, Albuquerque Convention Center, 848-1370.

Feb. 19 — Ballet Folclórico Nacional De México, Mexico's official folk troupe, music & dance; 8 p.m., Kiva Auditorium, 848-1374.

Feb. 20-28 — "La Bohème" by Giacomo Puccini, Albuquerque Opera Theatre/Opera Southwest production of a tale of love, jealousy, and youthful exuberance; 8 p.m. (2 p.m. Sun.), KiMo Theatre, 243-0591 or 243-8492.

Feb. 21 — "More Michael Martin Murphy," second appearance of the Taos country/folk star with the New Mexico Symphony Orchestra, conducted by Roger Melone; 8:15 p.m., Popejoy Hall, 843-7657.



GATEWAY TO SANDIA for most visitors and many employees is Bldg. 800.

(Continued from Page One)

Administrative Accomplishments

a 100 percent wall-to-wall property inventory to be completed and reconciled within ten months. (3410)

- The procurement divisions in Purchasing were reorganized in October 1985 to increase the level of service to the line organizations. The reorganization was based on a study of procurements during the three preceding years, interviews with each VP administrative assistant, and an analysis of the resources available within Purchasing. After reorganization, each organization at SNLA has an assigned buying group primarily responsible for the group's procurements. (Exceptions are made for specialized areas such as shop fabrication, manpower services, construction, and computer procurements.)

A survey of all SNLA divisions in July 1986 indicated that 62 percent of the divisions responding experienced better purchasing services after reorganization, 23 percent felt that the services were about the same, and 9 percent either had no opinion or were unaware of the reorganization. (3700)

- Organization 9000 (then 300) presented the Technical On-Site Inspection (TOSI) program to Plant Engineering, Purchasing, and other administrative organizations in August 1986 as a basic layout and verbal concept design criteria with a completion date of Dec. 1. By that date, the site was opened for full operation at a cost of \$1,350,000. A 5kV overhead power supply was designed to service the site. There are approximately five miles of trenches for underground utilities, 420 cubic yards of concrete, and 5500 feet of site fencing. Two mobile offices and one metal building erected on-site provide 5000 sq. ft. of space. Special systems include intrusion alarm, fire alarm, video, and communications functions. A railroad turnout and switch and 820 feet of open track and 465 linear feet of concrete-encased track were also constructed. (7830/3700/3155)

- TLC (Total Life Concept), Sandia's comprehensive health promotion program, began in January 1986. The goal of TLC is to help Sandians develop and maintain healthy lifestyles. The major steps in the TLC program are to help employees: understand health risk factors such as obesity, smoking, high-

fat diets, and lack of exercise; identify their individual health risk factors; eliminate or reduce these risks and adopt healthier lifestyles and habits; and maintain these new, healthier lifestyles.

To date, about 1400 Sandians have participated in TLC. Participants are enthusiastic about the program, and early results show that employees are indeed changing their lifestyles. (3330)

- Public Relations developed a comprehensive "PR Strategy for the Future" that emphasizes more in-depth information for employees, such as that provided in the 19-minute videotape and the weapons special issue of the LAB NEWS produced for the successful Family Day in October. The videotape was produced by Motion Picture-Video Services Division 3153. (3160)

- Family Day 86 involved most other administrative organizations as well. Key roles were played by Security, which was responsible for ensuring security on a day when several thousand uncleared visitors were allowed to enter the Tech Areas, and Plant Maintenance, which upgraded the appearance of the Labs, helped build exhibits, and arranged for visitors. (3400/7810)

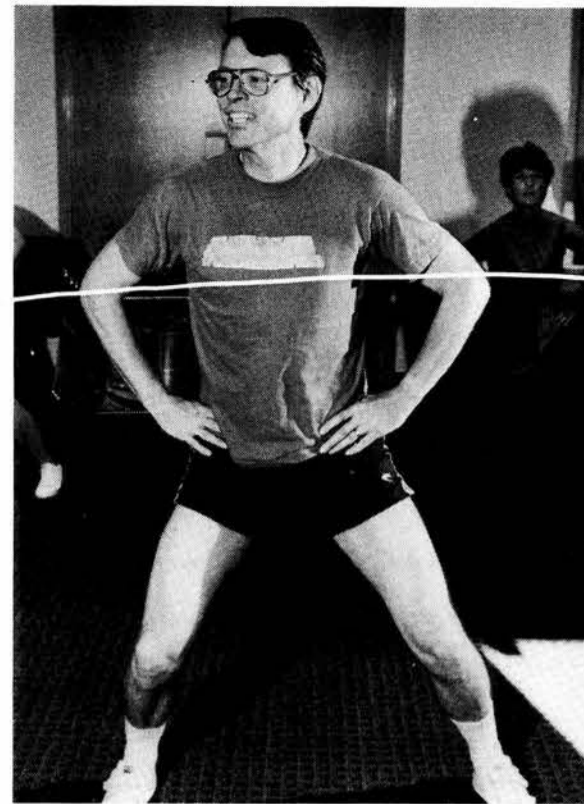
- To decrease administrative expense and provide the maximum funding for benefit claims, the Benefits Department converted some insured benefit plans to self-funded plans. Sandia's Medical Care Plan became self-funded on April 1, 1986. Annually, this should reduce administrative and insurance retention expenses approximately 75 percent. The Dental Expense Plan and Vision Care Plan are also self-funded. (3540)

- Construction was completed on a Radar Cross-Section (RCS) Measurement Facility to obtain high-resolution measurements of relatively large targets in an RF-reflection-free environment at K-band frequencies (35 GHz). The heart of the project is an anechoic chamber 42 ft. wide, 110 ft. long, and 26 ft. high that houses a "compact range" for radar cross-section measurements. The chamber and the building that houses it are structurally separated to reduce mechanical vibration of the chamber. The temperature in the chamber must not fluctuate more than 1° up or down during testing to prevent thermal straining of the compact range reflector and targets. (7830)

- The Education and Training Department was the linchpin in the design and development of a comprehensive orientation program for new professional staff. Under the aegis of the Professional Staff Orientation (PSO) Program Committee, PSO was the first of a three-part program in which new MTS, MLS, and TSA employees are given a broad perspective of Sandia's ethos, mission, technical activities, and role in the R&D community and the nation at large. The week-long program, featuring technical overviews, videos on Sandia services, and tours of the Labs, also emphasizes the interdependence of organizations in the Labs and specific roles and responsibilities of professional staff employees in helping the Labs achieve its goals. The overall aim of PSO is to help new professional staff employees make a smooth transition into Sandia, feel a part of the Sandia culture sooner, and have tools and information that make them more effective on the job earlier in their careers. Nearly 100 Sandians with up to two years' service completed the pilot program held in November. (3520)

- DOE asked the classification organizations to create comprehensive and detailed classification guides for areas of Sandia specialties in nuclear weapon R&D. Guides on initiators and on safing, arming, fuzing, and firing have already been produced. Additional guides are now being developed for materials; use control; non-nuclear testing; vulnerability and hardening; and production, stockpile, and military utilization. (3180/8020)

- 25 Just-In-Time contracts for maintenance and operating supplies were awarded. The Just-In-Time contracting system replaces General Stores warehousing, saving FTEs and warehousing space, reducing the cost of supplies, and eliminating inventory obso-



CHARGED UP by aerobics and taking charge of his health is Larry Ebinger (7121), one of the first Sandians to enroll in TLC's pilot program. Other classes that have been running strong since the TLC program officially began in January of last year are stress management, weight control, and exercise (walk/jog on the track).

lescence and shrinkage. Contracts awarded included contracts for office supplies, photo processing, lumber, metal raw stocks, plastic raw stocks, rubber stamps, safety equipment, photographic supplies, paint, computer supplies, computer hardware, computer paper, O-rings, janitor supplies, heating and air conditioning supplies, electrical supplies, tires, plumbing supplies, fine paper, drafting and blueprint supplies, gases, chemicals and laboratory supplies, fasteners, graphic arts supplies, and general industrial supplies and equipment. (3740)

- The Management Information Data Access System (MIDAS) was implemented in March 1986. MIDAS is a menu-driven system providing on-line capability for management reporting of administrative data. The initial implementation of MIDAS as part of the administrative network (ADNET) provides terminal-based financial reporting capability and has the ability to download cost/budget and purchase order/purchase requisition data to personal computers. (2620)

- In cooperation with all other Sandia Albuquerque organizations, Plant Maintenance spearheaded a major site cleanup of unnecessary material around and within laboratories, offices, corridors, etc. A total of 295,240 cu. ft. of excess furniture, scrap material, trash, stored materials, and hazardous waste was removed and delivered for proper disposal. (7810)

- A structured writing style permitted cancellation of approximately half of 287 SLIs. As each SLI is reissued, the underlying systems are analyzed to streamline procedures wherever possible. As part of this effort, approval levels have been reduced to the lowest necessary for adequate controls. (The most popular reduction has been that staff members may now approve purchase requisitions of \$1000 or less.)

The structured writing style continues to receive praise from both staff and managers; the most frequently mentioned improvement is the margin labels that lead the reader to the desired text. (130)

- The ongoing preventive maintenance, or Automated Maintenance Management (AMM), program was enhanced by a 30-percent increase in software capability. The computer list now includes 40,000 preventive maintenance actions needed for 17,000 pieces of equipment. The AMM work measurement coverage was extended to the mechanical utility and steam plant functions, and the work backlog was reduced from five weeks to one week, resulting in improved response time. (7810)

- Common forms have been developed for Livermore and Albuquerque, thus reducing the amount of forms design effort required at Livermore. (130)

Some Statistical Gee-Whizzes for 1986

- The technical libraries at SNLA and SNLL provided an average of 30 items to each of the Labs' approximately 3000 technical professional employees. The Albuquerque library circulated 80,000 items, the Livermore library 10,000.

- Div. 3522 presented more than 100 courses to more than 1300 Sandia engineers, technicians, and scientists. Thirty-one of these courses were offered on Instructional Television, completing the successful first year of ITV at Sandia.

- \$510 million worth of commercial orders were placed, and 814 suppliers with 2400 contracts were audited. Sandia and/or contract auditors travel an average of 13 weeks per year in visiting suppliers in 48 states.

- Sandia is responsible for \$1 out of every \$1000 spent by the federal government.

- The Benefits organization served 30,000 employees, retirees, dependents, and surviving spouses.

- 145,000 medical, dental, vision, life, and other insurance claims were processed.

- 32,400 patients visited Medical, an average of 130 per workday.

- 3412 employees did not have a single day of sickness absence.

- 38,051 days of sickness absence were used, an average of 4.6 days per employee.

- Participants in the first two TLC sessions lost more than 600 pounds.

- More than 20,000 personnel dosimetry badges were processed by Environment, Safety, & Health Dept. 3310.

feed *li*back

Q. I and several other Sandians have observed that:

1. Sandians (and their families) are, relatively speaking, a healthier group than average.
2. Sandia offers several health plans, and Sandia bears the burden of those premium costs.
3. Sandia employees do not receive an amount (in benefits paid by carriers) equal to the premiums paid out.
4. Our self-insured workers' compensation program has proven successful and cost effective.

I believe that we could institute a self-insured health/dental program that would cover 100 percent of medical/dental costs, and be more cost-effective than our current multi-carrier programs.

A. The current benefit structures of the Sandia medical and dental plans are modeled after the AT&T medical and dental benefit structures. The Sandia Dental Expense Plan has been self-funded since January 1, 1984, and the Sandia Medical Care Plan became self-funded as of April 1, 1986. Under a self-funded arrangement, Sandia pays the actual claims expense and a negotiated claims administration expense.

Despite your observation that Sandians are a relatively healthy group, our most recent statistics show that Sandia is well above the national norms for hospital length of stays, hospital days per 1000 covered participants, and other utilization statistics. As with most health benefit programs, we find that 20 percent of the population incur 80 percent of the cost. Sandia's health care costs have increased approximately 150 percent in the past five years due to medical inflation, plan improvements, and a growing retiree population.

The health and dental plans are only a part of Sandia's benefit package for employees. The dental and medical plans, along with the many other benefit programs provided by Sandia, are continually evaluated to remain competitive both locally and nationally. Currently, no changes to the medical or dental plan benefit provisions are being considered.

Ralph Bonner - 3500

* * *

Q. Trying to reserve a conference room can be frustrating. Why don't we have centralized reservation facilities for all true conference rooms? Twenty-seven conference rooms are listed on Page 24F of the Sandia phone directory. Several are not listed at all, such as the two in the Visitor Center. Trying to find a room that meets requirements (right size, available at the right time, port-contender access, in-room phone for dial-up computer access, desired audiovisual facilities, outside secure gates for ease of access by uncleared visitors, etc.) can eat up considerable employee time. At the moment, the best we can do is make one phone call after another until a reasonable solution occurs. All conference rooms that are available for general Sandia use should be so designated. One employee could be in charge of coordinating all reservations and knowing pertinent facts about the rooms. Keys could be maintained locally.

A. We recently examined conference room scheduling in an attempt to meet a variety of needs, including those mentioned in your question. We agreed that it would be best to have one person scheduling all of the generally available rooms. However, budget and staffing constraints have prevented us from implementing this approach. We hope to implement central room scheduling in the future if current limitations change.

Ralph Bonner - 3500

* * *

Q. What is the history of the cooperation between Sandia Labs and the Air Force concerning recreational and athletic facilities? Specifically, who bought what facilities and when? Why are Sandians now required to pay a minimum of \$24 per year to

use these facilities? Is this an isolated case of reduction in employee benefits, or is this the beginning of an overall change in employee benefits?

A. Generally, the military has been most cooperative in sharing athletic and other recreational facilities with Sandians and with other Defense Department contractor personnel on base. The facilities are "owned" by the military, which has absolute authority on their use. Other DoD contractors have been paying the \$24 annual fee for access to Morale, Welfare, and Recreation facilities since 1983; Sandians and their dependents are now being asked to do likewise.

This is not a reduction in your benefits since access to these facilities has always been strictly at the pleasure of the military — it has first priority on the use of its own facilities. You should weigh the value of access to the facilities and decide whether it is worth the annual \$24 fee.

Ralph Bonner - 3500

* * *

Q. Parking is at a premium in the lot near the water tower east of the motor pool, but some Sandians apparently can't read the marked bumpers. From the designations "visitor" and "official business," they seem to imply they are visiting the parking area and they are officially coming to work. I know they are not from outlying areas because they work in the same building as I do.

A. SNL employees are expected to comply with corporate rules and regulations, which include parking rules.

Employees are prohibited from parking in visitor spaces at all times.

At Sandia Albuquerque, "Employee on Official Business" spaces are provided near each TA-I Gate, Medical, Personnel, and Plant Engineering. The primary intent is to provide reasonably convenient parking for those employees who drive from outlying areas to attend meetings or attend to other business. There is a two-hour limit on parking in these spaces, unless otherwise indicated. Employees are not to use these spaces as a matter of routine or for when arriving late to work. These areas are patrolled, as priorities allow, tires are chalked, and citations issued. Employees observing violations of parking rules are encouraged to report them to the Parking Enforcement Section, phone 4-6410. Complaints will be checked and citations issued to offenders.

Jim Martin - 3400

* * *

Q. Why is there a lag-time of more than 1-1/2 months in publishing values of the AT&T Savings

Plans? This makes it difficult and somewhat risky to make changes in investment direction and withdrawals. Public mutual funds and stocks publish their values daily. Even though the values are published only monthly, can't they be made more timely?

A. AT&T has been experiencing interim delays in calculating and reporting the unit values because of the AT&T divestiture and the restructuring of the savings plans. AT&T will return to its once-a-month reporting schedule as soon as possible. As you may know, Sandia has no control of the publishing schedule for unit values; we publish them as soon as they are received from AT&T.

Ralph Bonner - 3500

* * *

Q. I submitted a "Process and Fabrication Request" for \$80,000 to one of the shop organizations. Later I was informed that \$106,000 was charged against that request and the account was still open for additional charges. Who is responsible for monitoring the amount of charges against a request? Who is responsible for charges in excess of those authorized?

A. The dollar amounts on a Process and Fabrication Request (F-order) are estimates made jointly by the project (customer) organization and the shop organization. The amounts are shown as estimates because of the nature of the shops' business, i.e., process and fabrication development of first model hardware, often from incomplete and constantly evolving definitions. Requested quantities of prototype hardware continually vary without corresponding changes in F-orders. The Process Development staff and customers are the principal policemen for costs charged against an F-order. All charges applied to F-orders are charged against the case direct support subscription, even when they exceed the cost estimates, as required by SLI 9110. F-orders are closed out by employees in 7400 when the work is completed or when requested by customers.

Even though accurate cost estimates are often not possible, the Process Development Labs try to stay within the estimates. However, the present Sandia F-order cost accounting system does not supply information that is timely enough to provide a satisfactory level of control. The members of the staff of 7400 are currently attempting to improve the situation without prejudicing the flexibility of their response. The flexibility in response results from a high incidence of design, schedule, and quantity changes during the fabrication process. Until the cost control system is improved, close and active communication between staff in the project organizations and the responsible shop section supervisor is recommended. The Process Development staff can often accommodate special customer cost requirements.

Jim King - 7400

* * *

Q. It disturbs me that Sandia refuses to renew ID cards when an employee's appearance has changed markedly. Yet, Security requires the badge picture to be up-to-date. Some of us use our ID cards frequently while traveling and would like an up-to-date picture, especially for visits to security installations. (Try getting into a lonely Air Force installation at 2 a.m. with a picture that doesn't look like you.) If my old badge picture wasn't good enough for Sandia Security, why is the same picture on my ID card good enough for everyone else's security? Isn't there some way I could get a new card, with high management approval, if necessary?

A. Your complaint is valid, and we have now changed the procedure to accommodate your request. When there is an appearance change that necessitates a new badge, we will also provide a new ID if the employee requests it.

Jim Martin - 3400

On the Odds of AIDS

"AIDS: What Your Risks Are and Are Not" will be the title of a presentation at Sandia by Suzanne Popejoy, epidemiologist with UNM Hospital. The talk is scheduled for Tuesday, Feb. 24, from 12 to 1 p.m. at the Technology Transfer Center, Bldg. 825.

Copies of the Surgeon General's recent report on AIDS (Acquired Immune Deficiency Syndrome) will be handed out at the time.

AIDS is a major public health issue. Its impact on our society is — and will continue to be — devastating. The Surgeon General estimates that 1.5 million people in the U.S. — both homosexuals and heterosexuals — are already infected with the AIDS virus and are assumed to be capable of transmitting it. The talk will cover ways in which people can take preventive measures.

Take Note

Dwight Miller and Alan Swain (DMTS; both 7223) wrote a chapter for the recently published *Handbook of Human Factors*. The chapter, entitled "Human Error and Human Reliability," describes the state of the science and includes an in-depth treatment of THERP (Technique for Human Error Rate Prediction), developed at Sandia to assess human error probability in nuclear weapon assembly and field use. The handbook is one of the most complete in the field, and should be a useful reference document in human factors.

* * *

A paper by Thom Fisher (2126), "Power MOS-FET Usage in Radiation Environments: Circuit Design Techniques and Improved Fabrication Methods," has been selected by the 1986 Government Microcircuit Applications Conference for its Meritorious Paper of the Conference Award. Two duplicate plaques (one for Thom and one for Sandia) will be presented to Thom at the 1987 Conference banquet.

* * *

Mr. Wizard (Don Herbert) recently sent Rod Geer (3161) a merit award from the Mr. Wizard Studio, the National Science Foundation, and the General Motors Research Laboratories for Sandia's contribution to the TV program "How About..." (the science series of TV news reports). Mr. Wizard said in his letter, "The material you supplied to us was seen by millions of Americans who watch newscasts on our network of local television stations." Rod was the Public Information Division contact who coordinated the transfer of information to the Mr. Wizard Studio.

* * *

Sandians may have noticed that Susan Harris (3330) and TLC consultant Karen Cox have a weekly column, "Eat Right," appearing in the *Albuquerque Journal*. The column began Jan. 15 and runs through March 5 in conjunction with HealthNet New Mexico's 10-week program, "Eat Right New Mexico." This program, to be introduced every January for the next 10 years, is a 10-week behavior change program with two goals for participants: nutrition awareness and weight loss.

* * *

Free renewable energy and energy conservation seminars, information, exhibits, video tapes, commercial and non-commercial displays, and "Solar for Kids" displays — they're all part of the third Albuquerque Solarfest presented by NMSU's New Mexico Solar Energy Institute. The Solarfest is Feb. 21 at the PREP Bldg. on the TV-I main campus. The "Solar for Kids" display features the basics of energy conservation and solar energy use taught from models and toys in a "fun" atmosphere. More than 40 seminars will be presented from 9 a.m. to 3 p.m. They include: heating with wood, architectural design for passive solar, passive solar remodeling, passive solar for commercial buildings, and energy-efficient mobile homes. For further information and/or a program, call the Sun Dial on 1-800-432-6782.

* * *

Style: how to get it; how to use it. Image Avenue is sponsoring a seminar, "Insights in Style," on Feb. 26 from 6-7:30 p.m. at the Amfac Hotel, to benefit the Albuquerque Shelter for Victims of Domestic Violence. Enjoy an evening of ideas and demonstrations on how to look great by making the most of the figure and the wardrobe you already have. Nancy Elorduy, nationally known wardrobe and image consultant, will lead the show. For more information, call Maggie Gregory (wife of Bob, 2100) or Merle-Dean Sanchez on 292-3775.

* * *

Students from the Armand Hammer United World College of the American West will present "Have a Heart for Children," a program of international music and entertainment, at the KiMo Theatre on Feb. 22 at 2 p.m. The program, sponsored by the Albuquerque UNICEF Advisory Council, is a fundraiser for a UNICEF program in Mexico to provide rural primary health care. For more information, contact the UNICEF Shop on 843-6636.



SANDIA WAS HONORED last month for its support of the National Guard and Reserve program with a plaque, the State Chairman's Award. Sandia was nominated for the award by George Treadwell (7213; left), Commander of the 111th Air Defense Artillery Brigade and a brigadier general in the NM Air Reserve National Guard. Art Davie, Administration VP 3000, accepted the award for Sandia; here, Art is congratulated by Dean Irvin (ret.; right), State Chairman for Reserve Affairs.

Welcome

Albuquerque

James Eckles (22-2)
Anne Gigante (21-1)
Anne Gomez (2631)
Rosemary Hriczko (3426)
Moises Lucero (3426)
Lilia Martinez (22-2)
Paula McKee (3411)
Catherine Pasterczyk (3144)
Susan Romero-Sosa (2631)
Randolph Shibata (3714)
Christine Tomlin (21-1)

Arizona

John Reddy (2629)

Colorado

Raymond Trechter (2625)

Illinois

Lawrence Fox (5261)
Suzy Wagner (21-1)

Missouri

Charles Girard (7862)
Mark Richards (5164)

Nebraska

Glen Ankenman (5252)

New Mexico

Sherrie Jones (21-1)
Dennis King (7812)
Betty Walkup (21-1)

Texas

Scott Morgan (2625)
Karen Weber (9211)

'Model of Executive Vice-President'

Stanza 1

He is the very model of Executive Vice-President,
On atomic information he's Sandia's guru-resident;
He knows effects of weapons and all the tests historical
From Trinity to Misty Rain, in order categorical;
He's very well acquainted, too, with matters mathematical.
He understands equations, both the simple and quadratical.
About binomial theorem he's teeming with a lot of news,
With many cheerful facts about the square of the hypotenuse.
Chorus
With many cheerful facts about the square of the hypotenuse,
With many cheerful facts about the square of the hypotenuse,
With many cheerful facts about the square of the hypotenuse,
With many cheerful facts about the square of the hypotenuse;
He's very good at integral and differential calculus;
He knows the scientific names of beings animalculous;
In short, in all his expertise, with which he's never hesitant,
He is the very model of Executive Vice-President.

Stanza 2

He knows of British weaponry, King Arthur's and Sir Caradoc's.
He answers hard acrostics, has a pretty taste for paradox.
He can quote in elegiacs all the crimes of Heliogabalus!
In conics he can floor peculiarities parabolus.
He knows atomic history from Lilienthal to Herrington.
He exercises bravery from derring-do to daring-done.

Chorus

Then he can hum a fugue of which he's heard the music's din afore,
And whistle all the airs from that infernal nonsense, Pinafore.*
And whistle all the airs from that infernal nonsense, Pinafore,
And whistle all the airs from that infernal nonsense, Pinafore,
And whistle all the airs from that infernal nonsense, Pinafore,
And whistle all the airs from that infernal nonsense, Pinafore.
He writes his memoranda in what seems Kentucky cuneiform
And tells you ev'ry detail of Ray Romatowski's uniform.
In short, in all his expertise, with which he's never hesitant,
He is the very model of Executive Vice-President.

*A reference to Gilbert and Sullivan's earlier operetta, *H. M. S. Pinafore*

LAST FALL, we had space for only part of former President George Dacey's parody of Gilbert and Sullivan's "Model of a Modern Major General" from their operetta, *The Pirates of Penzance*. The parody, "Model of Executive Vice-President," honored (that may not be quite the right word) Executive VP Tom Cook on his impending retirement. This issue — in response to a number of requests — we give you the complete version.

Merchant Prince, Heart Engineer Size Up China

When Eldon Boes, supervisor of Photovoltaic (PV) Technology Division 6221, and his wife Joan had a chance to visit China last August, they gladly went.

Eldon saw a chance to be a "merchant prince of old" — in a country that's scurrying to catch up with Western technology — by presenting three papers at the Second International Photovoltaics Science and Engineering Conference (PVSEC-II). And Joan, a nurse who's studying to be a psychologist, was intrigued by the chance to visit some public health institutions.

During the week preceding the conference, Eldon (and two DOE people who also presented papers) visited a dozen research institutes, companies, and universities in Beijing (the capital) and Shanghai. The tour was tailored and arranged by the U.S. Consulate.

"Those visits gave us the first thorough reading on what is happening with PV R&D in China," he says. "I found that China is about four or five years behind the U.S. in its ground-based technology. Some research groups have adequate facilities and are making credible progress. So now we have a much better idea of potential applications in that country."

And PVSEC-II? It's an important conference to PV researchers, second only to the IEEE-sponsored PV Specialists Conference, according to Eldon. "Besides providing a comprehensive review of the status of photovoltaic R&D worldwide, PVSEC-II offered up-to-date information on what the Japanese are doing," he says. "Also, it gave us a glimpse of the work — and plans — being carried out in the People's Republic of China." For example, China has installed a variety of experimental PV power systems for communications, railroad crossing systems, and weather stations.

The U.S. government is eager to have industry sell PV products and/or technology worldwide, according to Eldon. "And although China won't buy products, it'll buy technology," he predicts. "It has already signed agreements on two joint ventures under which U.S. companies [both DOE contractors, one also a Sandia contractor] will build PV manufacturing facilities there."

Local Power Needs

China's need is greatest in rural areas where electric power supplies are either inadequate or completely lacking. Although Eldon couldn't get a precise statistic on just how many people are without electricity — the estimates ranged from 15 to 50 percent — the population is gargantuan enough (more than 1 billion) to make on-site power generation systems (such as local hydropower plants, wind machines, and PV systems) an attractive alternative.

Today, electricity is used sparsely in homes:



GREAT HIKE UP GREAT WALL for Joan Boes (left) and Marty Leopold (right foreground) of Jet Propulsion Lab. The Great Wall may have succeeded in repelling the Mongolians for several centuries, but today it's overrun by tourists.



LINED UP on a rooftop in front of a photovoltaic concentrator are researchers from the Tianjin Institute of Power Sources (host of PVSEC-II) and Mort Prince (second from right) from DOE. "The collector, an experimental unit built in China, has one-sq.-ft. Fresnel lenses and is very similar to the ones developed through Sandia's program," says Eldon Boes (6221).

most often it's simply a single bare bulb (dangling from the ceiling), a TV, a water pump, and a fridge. There are no street lights, no neons. Even Shanghai, the largest city (with a population of 12 million), is dark at night; Joan recalls that flying into the city "felt like driving into Socorro."

Flow of Society

The most noticeable feature of public life in China today is the even, slow pace of large masses of people. To Joan, it was epitomized in bicycle traffic: "All the bikes travel at the same speed, 8-10 mph. City buses are packed with people, yet they all kind of flow."

Both Joan and Eldon had a distinct impression that food is very important. "The most frequent expression seems to be 'Have a nice lunch,'" says Joan. "And the people say they're 'counting mouths' instead of 'counting heads.'"

Although a grocery store may be completely empty of food at one time of day, a shopper may later find a flatbed truck with mounds of packaged noodles standing in front of it. (That's in the north; the southern part of the country subsists mainly on rice.) In contrast to the ample but monotonous meals of the Chinese, the buffet banquets for foreign visitors often have 15 to 20 dishes to choose from.

Both noted that the social — and political — emphasis is not on the individual, but on the group. "People are punctual and polite," she remembers. "And congenial, almost shy. The faces are passive, showing no anger or rage — you really feel the contrast when you bump into Americans. There are no street people. And everybody's thin; they exercise religiously — out in the open."

While the military arm of the nation was not visible on street corners (as it is in the U.S.S.R.), Eldon felt more subtle forms of control. People need permits to move to another city and/or to change jobs. They're very law abiding. Most families have only one child, particularly in the cities where it's easier to impose economic sanctions — educational penalties or loss of food rations — against parents who over-replicate themselves.

Centralization is least evident in the local villages, comprised of thousands, or even tens of thousands, of people. The villages are given a lot of autonomy in terms of growing products and constructing

the buildings they need, even though the government sets the prices on what they sell. The villagers most often live in apartment buildings — one to three stories high — and walk to the farms.

From Pallor to Color

Then there's fashion. Mao suits are out. Polyester is in: most often white shirts and dark pants for men, dresses or slacks for women. People look very neat, dressed in their Sunday best even on weekdays. "The colors are getting more cheerful," observes Joan. "It's as if the people had been squished but are bouncing back. You can tell by looking at the older temples that the Chinese were always fascinated by brighter colors. And it feels like that color is coming back."

"China is changing rapidly, at an unbelievable pace," she continues. "After the Cultural Revolution, it's like everyone's in therapy, constantly talking about the trauma." Since 1980, the *dazibao* (large-character posters) are no longer the chief vehicles for political expression. "Now some newspapers, such as the *China Daily*, publish critical articles — even though they're not strident," she says.

"The tough thing to predict is how long it'll all last," adds Eldon. "No one knows. However, it appears that the changes are making it more and more difficult to go back to a stricter, more repressive regime."

The Chinese are trying to downplay binding, dogmatic economic targets. "But it's obvious that they are determined to be technologically self-sufficient," he observes. "They're making their own tractors, their own trains, rockets, bikes, TVs, ICs, and instrumentation for the labs."

"It seems everyone is an engineer in China," muses Joan. "In fact, I had a tough time explaining what my next career will be. I tried describing to one fellow what a psychologist does: that I'd be talking people out of committing suicide and teaching them how not to be depressed. There was a long silence as he mulled that over. Then, he got it. 'Ah, so when a heart breaks, you fix it,' he said. 'What you are, then, is an engineer of the human heart.'"

•ID

(Ed. Note: This article was written before the recent surge of student uprisings in the People's Republic of China.)



BICYCLE IS WAY OF LIFE in Beijing. "You can get any bike you want," says Eldon Boes (6221), "as long as it's black, one-speed, and has 26-inch tires." Throngs of pedalers are probably in nearby Tianamen Square, some visiting Mao's tomb, some the Forbidden City.

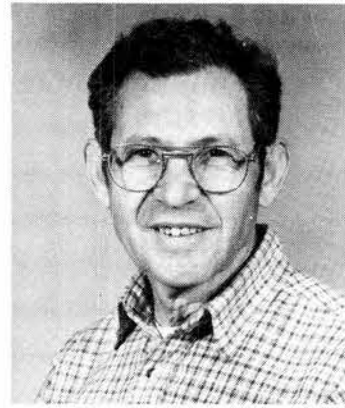
MILEPOSTS

LAB NEWS

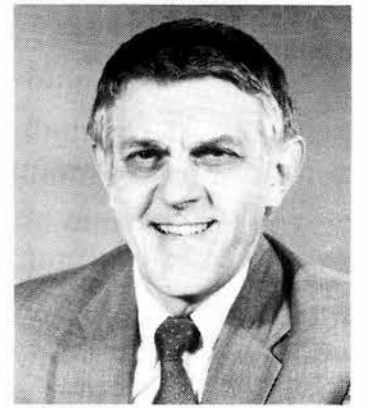
FEBRUARY 1987



Frank Conrad (5248) 35



Preme Ulibarri (7535) 30



Marv Coon (3544) 30



Fred Yost (6332) 15



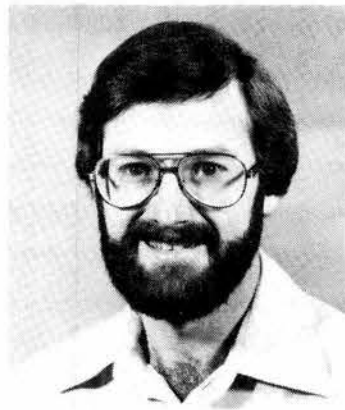
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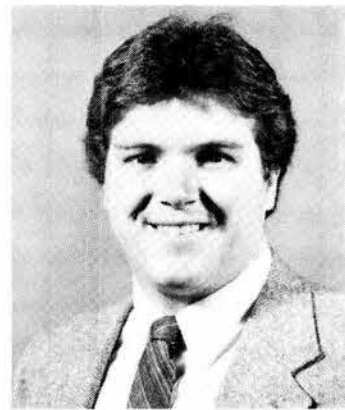
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Jim Dawson (7842) 10



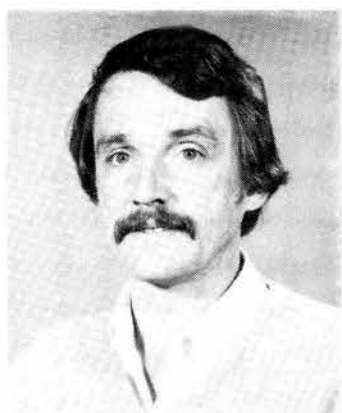
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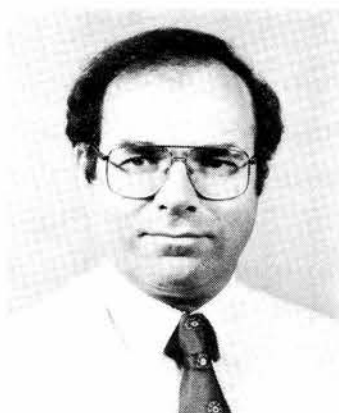
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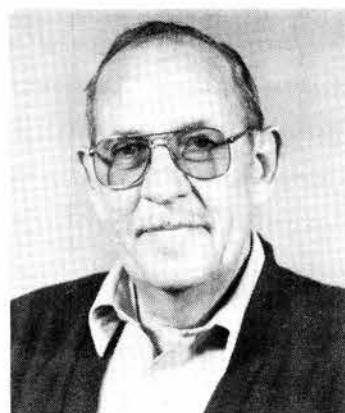
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Mike Deveney (2126) 10



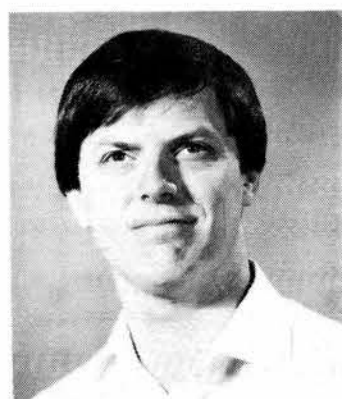
Allan Benjamin (6411) 10



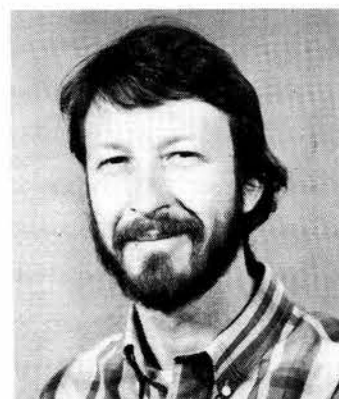
Neal Rozell (7811) 35



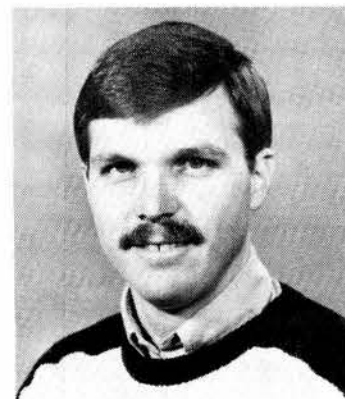
Louis Roper (7810) 20



George Davidson (1412) 10



Richard Heintzleman (2345) 10



Joe Roesch (5214) 10

UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS

Deadline: Friday noon before week of publication unless changed by holiday. Mail to Div. 3162.

Ad Rules

1. Limit 20 words, including last name and home phone.
2. Include organization and full name with each ad submission.
3. Submit each ad in writing. No phone-ins.
4. Use 8 1/2 by 11-inch paper.
5. Use separate sheet for each ad category.
6. Type or print ads legibly; use only accepted abbreviations.
7. One ad per category per issue.
8. No more than two insertions of same ad.
9. No "For Rent" ads except for employees on temporary assignment.
10. No commercial ads.
11. For active and retired Sandians and DOE employees.
12. Housing listed for sale is available for occupancy without regard to race, creed, color, or national origin.

WANTED

- HIGH SCHOOL STUDENT to spend '87-'88 in Germany; German student would stay with your family in exchange. Elder, 298-5350.
- FURNISHED HOUSING for summer Sandia employees, responsible college professors and graduate students who will arrive in May or June and leave in August or early September. Markey, 4-5656 or 4-8458 by Feb. 27.
- BABYSITTER, Menaul/Chelwood area, 2-yr.-old boy, M-F, 7:30 a.m.-5 p.m., paid vacation; housecleaning person for 4 hours weekly. Dubicka, 296-6557.
- OTAGIRI STONEWARE RICE BOWLS, Horizon pattern; old cameras. Orear, 256-1941.
- STATIONARY EXERCISE BIKE, reasonably priced. Potter, 299-6053.
- RIDER/DRIVER to and/or from Missouri in May. Long, 294-4591.
- TO BORROW: VHS videotape of the 1987 Rose Parade. Patrick, 822-0703.
- MEDIUM-SIZE DOGHOUSE for small price. Gregory, 299-8029.
- PIANO, in good working condition, for less than \$400. Snyder, 898-5962.
- PAPER CUTTER. Coulter, 867-2127.
- TO RENT: reasonably priced condo/beach house on islands of Kauai, Maui, or Hawaii, from March 22 to 27. Ricker, 293-1847.
- HOUSEMATE, share house 10 minutes from Eubank gate, nonsmoker, pet OK. Boslough, 294-3907.
- GYMNASTICS EXERCISE MAT, for beginning gymnast. Leger, 292-4393.
- ENCYCLOPEDIA, in good condition. Eckhart, 294-4742.
- TO COPY: tapes of "Reilly - Ace of Spies." Lachenmeyer, 268-7475.
- HOUSEMATE, to share 3-bdr. house in NE Heights, nonsmoker preferred, \$240 plus 1/2 utilities. Tomek, 299-0471.
- CLOTHING, furniture, household items — used, but decent; or cash donations for a group of developmentally disabled Navajo Indians. Ruby, 299-0767.
- HOUSEMATE, to share 3-bdr. house in NE Heights. Gachupin, 293-6538.

MISCELLANEOUS

- AERIAL PHOTO of Labs, 16" x 20", mounted, \$20; Sandia and TLC T-shirts, \$7; Sandia caps, \$7. South Highway 14 Project, LAB NEWS, Bldg. 814.
- TWA FLIGHT COUPON, transferable, \$200 worth of travel to any TWA destination, cash or trade for other airline coupons. Dubicka, 296-6557.
- BARBECUE, for charcoal, wheels, \$10; 20-lb. propane tank w/regulator and hose, new, \$20. Stromberg, 255-6131.
- SKIS, women's, name brand, boots, poles, used twice, \$135 OBO. Mar-

- chi, 291-9681.
- EXECUTIVE DESKS, wood, 36" x 70", 9 months old, cost \$395 new, asking \$150. Cleary, 881-4294.
- FREEZER, Kenmore, 9 cu. ft., chest-type, \$150. Woody, 892-2251.
- CARPET, multi-brown predominating, two 10' x 11', and one 11'6" x 13', \$60. Allen, 298-9833.
- YASEU FT-757 TRANSCEIVER and FRB-757 linear switch, w/manuals, \$700 OBO. Nogle, 1-587-2484.
- CARPET and pad, approximately 60 sq. yds., \$100. Mozley, 265-2625 or 299-4204.
- SCREEN DOOR, countertop/sink, traverse rod, fluorescent light, 25" B&W Zenith TV, steel barrier rails for pick-up, trade 4-lug wheel for 5-lug wheel. Long, 294-4591.
- MAGNAVOX STEREO CASSETTE DECK, turntable, receiver, cabinet speakers, remote control, \$175 OBO. Kawola, 298-5813.
- GUN CABINET, wood w/glass door, separate compartment at bottom, both w/lock, eight gun slots, \$85. Oberkampf, 292-4366.
- CHROME RIMS w/tires, 12x15LT, 4-ply, tubeless, set of 4, \$125 OBO. Potter, 299-6053.
- WASHER, Sears Best, heavy-duty, \$225; refrigerator, Sears, side-by-side, frost-free, 19.5 cu. ft., gold, \$225. Manzanares, 296-3828.
- TRAIL-STYLE SNOWSHOES, 62" x 10", \$35; 1 pr. Bear Paw, 28" x 13", \$35; all are wood and rawhide w/leather bindings. Chorley, 296-1454.
- FREEZER, 19.6 cu. ft., frost-free Kenmore upright, \$350 firm; new charcoal barbecue grill, \$40. Freshour, 256-9168 after 6 or weekends.
- COMPUTER TERMINAL, Epson monochrome, \$85; MGA video graphics card for Epson Equity I, \$95. Huffman, 296-0453.
- MAGNAVOX RADIO/PHONE, console, Italian-style, \$75; Lowrey spinet organ, \$300; weight bench w/110 lb. iron weights, \$90. Estes, 865-5525.
- DURST ENLARGER, 50mm and 75mm lenses; Kodak processor w/paper, film, and chemicals, \$200. Freedman, 298-2177.
- E-T MAG WHEELS, set of 4, 7-1/2x14 to fit Ford, includes centering lugs and nuts, \$200. Brandon, 836-5621.
- REAR BUMPER for '56 Ford, w/exhaust cutouts, re-chromed. Marquez, 344-8455.
- THREE-POSITION RECLINER, platform rocker, 3-light white pole lamp, vanity lamps (pr.), 2' x 9' braided hall rug, vacuum cleaner, Oster hand massager. Easton, 256-7717.
- COUCH, beige, 5-piece sectional, \$310. Meeks, 255-6142.
- TRAVEL TRAILER, '76 20-ft. Roadrunner, sleeps 5, gas/electric refrigerator, furnace, stove, shower, toilet, \$3200. Scott, 294-7183.
- QUEEN-SIZE MATTRESS/BOX SPRING set, \$35, delivery available. Dykhuizen, 281-9463.
- BEDROOM SET: dresser, nightstand, headboard, mirror; coffee table, end table, Mediterranean-style, walnut-veneer finish. Helling, 281-5536 or 294-0582.
- UPRIGHT PIANO, \$375; professional blind-hemming machine, \$75. Melvin, 298-6402.
- RCA CONSOLE TV, 25", remote control, solid wood cabinet, \$300; bar stools, dark wood, \$25/ea. Furry, 294-6349.
- TYPEWRITER, portable electric Corona w/changeable Greek and math-type symbols, \$90. Kenna, 298-6059.
- CRAFTSMAN BELT/DISK SANDER, w/motor and stand, \$75; drafting machine, Vemco V-Track, RH and LH available, \$150/ea. Davie, 296-3950.
- ONE STEP CAR SEAT, for newborn to 43 lbs., w/cover, \$25. Stotts, 298-8894.
- KAYPRO II COMPUTER and Prowriter printer, w/standard software plus Turbo PASCAL compiler, \$500. Whalen, 822-0413.
- BANJO, Harmony Sovereign, 5-string. Ortiz, 293-4775.
- X-C SKIS, kids' sizes: 130cm, 150cm, 170cm, w/bindings, shoes, poles. Gerstle, 292-7422.

- ROLLTOP DESK, 2 file drawers, locking top, \$325; Fenwick heavy-duty bumper pool table, \$159. Paul, 299-6387.
- COFFEE TABLE, w/matching octagonal end table, glass and cane top w/brass border around glass, \$150. Barr, 821-5870.
- BUTCHER-BLOCK DINETTE TABLE and 4 chairs, \$100; 4 rattan bar stools, \$40/all; 2 cane swag lamps, \$30/both. Martin, 897-7660.
- MEMBERSHIP IN FLYING CLUB, 1976 Archer II, full IFR, \$12/hr. dry, plus \$30/mo. dues, \$1550 firm. Trujillo, 293-2132.
- 16-IN. RIMS, 6-hole pattern, normal width. Loucks, 281-9608.
- DINETTE SET, table and 4 chairs, \$50. Phillips, 821-9633.
- SELL OR TRADE: 1200-EGG INCUBATOR, for all sizes of eggs, \$350; child's desk and chair, green; need fencing or building material. Lackey, 898-6638.
- KITCHEN TABLE, octagon, w/1 leaf, 4 chairs; salon-style hair dryer; sun lamp; broiler oven. Phipps, 299-8490.
- WOOD ROCKER, \$25; stereo "Globe" speakers, \$25/both; moving boxes. Carter, 293-6750.
- FORD 302 ENGINE and automatic transmission, \$350. Campbell, 294-6000.
- SHOTGUN STOCK, Choate top-folder for Winchester 1200/1400, \$50 firm. Norwood, 266-2717 after 3:45.
- EXERCYCLE, Vitamaster, large seat, \$50; Sears B&W TV, 13", \$25; woman's bowling ball and bag, \$25. Fox, 266-6606.
- VW JACK (Fram), \$10; tire chains, 600-15, \$12. Johnson, 255-5427.
- SYLVANIA TV, 40", rear projection, remote control, \$700; FREID speaker system, large subwoofer, 2 satellite speakers, \$900 OBO. Nieto, 294-3565.
- ARABIAN FILLY, registered, 6 yrs. old, western pleasure-trained by Jim Miller. Hindi, 299-8996.
- DINETTE TABLE w/leaf and 6 chairs, \$50. Schneider, 299-6243.
- CAPTAIN'S BED, \$100; bronze chandelier, \$50; 2 nightstands, \$50. Haid, 292-0159.
- JACKMAN WHEELS, 5-hole, 15" x 7", with P/215/75R15 WSW tires, 4 complete, \$60. O'Bryant, 268-9049.
- WASHING MACHINE, Kenmore model 1156, 3-cycle, 3 temps., 3 yrs. old, \$90 OBO. Benavides, 897-1317.
- VIOLIN, handmade 1890s Jacobus Stainer antique, \$325; Atari computer system w/printer, new, \$400; drafting/artist's table, new, w/lights and chair, \$300. Campo, 299-2570.
- SONY COLOR TV, 17", remote control, bought in 1982, seldom used, \$200 OBO. Pendall, 265-3008.
- HEIERLING SKI BOOTS, size 7-1/2, \$20. Berman, 296-5640.
- HOOVER ELECTRIC FRY/BROILER PAN, \$20; classical music album (12 records), \$15. Campbell, 275-0789.
- DOUBLE BED, Sealy Prestige Posturpedic mattress, box spring, frame, \$275. Moss, 298-2643.
- SKIS, 175cm Head, fiberglass w/Look bindings, 7N Munari boots, poles, \$40. Dippold, 821-5750.
- GERMAN SHEPHERD PUPPIES, AKC-registered, 9 weeks old, 2nd shots, parents on premises, \$200/ea. Sjulian, 822-0494.
- FRONT HUBCAPS for 1980 GMC 4x4, free. Magnuson, 821-5330.
- S&W HANDGUN, model 27, 357, 4", blue, action-tuned, TS, TH, TT, WO, RR, 2 holsters, rug, and factory wood box, \$270. Moulton, 293-0373.
- DINING TABLE, mahogany, oval, gateleg, 42" L x 21" W, 13" drop leaves, no chairs, \$160. Dalphin, 265-4029.
- PUPPIES: Old English sheepdog/all-American fence climber, male and female, donations for building higher fence accepted. Shephard, 298-4879.
- BOOK COLLECTIONS w/rare volumes, Russian armed forces (75 vol.), general military and naval (100 vol.), Star Trek (85 vol.). Beck, 865-6137.
- DINING ROOM TABLE and 6 chairs, classic Mediterranean, \$500; pool table, \$200; Stair Glide chair elevator, \$200. Neal, 299-4956.

- RIFLES: .22 cal. semi-automatic, J. C. Higgins, scope .243 Mauser action, custom-stocked, 6-power scope. Tessler, 296-7587.
- ALUMINUM STORM DOOR, self-storing window, 36" x 80", RH, all hardware for installation. Walker, 821-5938.
- TWO PAIR ROCES SKI BOOTS, size 7; children's ski clothes; pool table; baby swing. James, 294-6837.

TRANSPORTATION

- '84 NISSAN MAXIMA WAGON, fully loaded, cassette, cruise control, OD, new tires, sunroof, complete maintenance record, \$7995. Burton, 869-2541.
- '79 351-M FORD PICKUP, long wide bed, 4-sp., 4-WD, radio/tape deck, 70K miles. Houghton, 299-3386.
- '74 DATSUN 710, 4-dr., AM, 4-sp., original owner, \$390. Picraux, 268-7126.
- '80 DODGE D-50 SPORT PICKUP, AM/FM cassette, sunroof, 2.6-liter engine, 5-sp., w/OD. Byars, 294-6676.
- '80 OLDS. 98 REGENCY, new diesel engine, 30 mpg, \$3495; '75 Revcon Class A motorhome, 10-12 mpg, 25 ft., \$19,500. Syme, 822-1321.
- '73 FORD PINTO HATCHBACK, 2000cc, AT, new tires, stereo cassette, 106K miles, \$500 OBO. Barnhart, 255-0574.
- '86 FORD PICKUP, 4x4, supercab, XLT, 6.9-liter diesel engine, AT, AC; '86 9-1/2 ft. Lance camper, self-contained. Cleveland, 299-7420.
- '75 PONTIAC GRANDVILLE CONVERTIBLE, 48K miles on rebuilt engine, \$800. Hente, 293-1546.
- '79 CHEV. VAN, factory customized, AM/FM, AC, cruise, icebox, table, couch, engine overhauled, trailer hitch, \$5700. Scott, 294-7183.
- '82 SCIROCCO, 5-sp., AC, AM/FM cassette, new radials and battery, 47.5K miles, original owner, \$5500 OBO. Weber, 897-2989.
- '73 MGB CONVERTIBLE, \$2500. Melvin, 298-6402.
- '74 CHEV. CHEVELLE, 2-dr., hardtop, 350 V-8, AT, AC, mag wheels, \$1100 OBO. Cordova, 884-9267.
- TWO SUBARUS, 360 engines, one runs, one in pieces. Coleman, 299-8321.
- '84 FORD RANGER, 4-sp., 4-cyl., AM/FM cassette, new tires and glass, 40K miles. Ortiz, 293-4775.
- '85 CORVETTE, 4-sp., 4.5K miles, two-tone bronze color, Bose stereo, one owner, \$24,750. Stotts, 298-8894.
- '78 OLDS. CUTLASS, V-8, 2-dr., AT, PS, PB, one owner, \$1995. Reed, 821-2195 evenings.
- '86 FORD F-150, PS, PB, AC, 6-cyl., 4-sp., LWB, white, 800 miles, \$9200. Padilla, 842-8068.
- '76 FORD ELITE, V-8, 57K miles, needs paint, \$1350. Jaramillo, 299-3441.
- '60 FORD 1/2-TON, for parts, \$75; truck and car rims. Padilla, 877-2116.
- '84 CHEV. CAVALIER CS, 4-dr., AC, F-41 sport suspension, custom two-tone paint, El Cuervo Especial sport pkg. Martin, 897-7660.
- '76 CHEV. PICKUP, LWB, V-8, 4-sp., w/shell, new steel tires, dual tanks, extras, \$2000. LeBlanc, 293-0516 after 5.
- '78 DATSUN KING CAB TRUCK, 5-sp., \$1350; Trek 560 bicycle, \$325; 10x15 6-hole rims w/Armstrong Rhinos. Loucks, 281-9608.
- '75 CHEV. LUV PICKUP, \$1350. Miller, 268-5992.
- '78 CHEV. MONZA, \$1500 OBO. Carlin, 292-5428.
- '85 CHEV. S-10 BLAZER, 4-WD, 4-cyl., 4-sp., 44K miles, \$9500. Misak, 281-2057.
- '84 HONDA PRELUDE, silver, 5-sp., AC, AM/FM cassette, power sunroof, one owner. Woodall, 822-0060.
- '73 HONDA CB350, 4-cyl., \$300. Carter, 293-6750.
- '79 DATSUN 510, 2-dr., hatchback, AC, 5-sp., \$1600. Tobias, 877-0354 after 5 or weekends.
- '75 AUDI FOX, fuel-injection, AT, AC, AM/FM stereo tape, new radials and battery, \$1700 OBO. Drotning, 294-4807.

- '71 OLDS. 98, 4-dr., dark green, fully powered, 94.6K miles, \$1000 OBO. Schwartz, 294-1113.
- '84 MAZDA 626, 2-dr. coupe, 5-sp., AC, AM/FM cassette, aluminum wheels, cruise control, \$6950. Clauss, 821-8840 or 266-9319.
- '82 FORD F150 XLT, AT, AC, PS, auxiliary tank, AM/FM tape, M&S tires, hitch, camper shell is carpeted and wired, \$5900. Leonard, 884-8566.
- '77 OLDS. 88, 4-dr., tilt wheel, power seats and locks, new battery and muffler, \$750. Martin, 822-8260.
- '76 CHRYSLER CORDOBA, white, cruise control, tilt wheel, AM/FM cassette, \$1000. Pfeiffer, 299-3951.
- '76 CHEV. MONZA, 86K miles, \$350 OBO. Berman, 296-5640.
- '85 NISSAN KING CAB 4x4, w/shell, \$7995; '82 Yamaha 250cc, \$500; '66 Ford, \$2400; '77 Cadillac, 60K miles, \$5000; Takara stunt bike, \$150. Campbell, 275-0789.
- '87 RENAULT ALLIANCE DL, 2-dr., AT, AC, PS, PB, \$7500. Campo, 299-2570.
- '72 CHEV. MALIBU, 2-dr. hardtop, 350 V-8, AT, AC, PS, PB, 64K miles, \$950. Grady, 296-5174.
- '74 DODGE DART, 4-dr., 318 engine, maintenance record, PS, PB, AT, AC, cruise. Nelson, 265-2248.
- '80 CUTLASS DIESEL WAGON, new rubber, AM/FM cassette, AC, PS, PB, gauges, electric locks, tilt wheel. Tenclay, 293-5584.
- '85 BRONCO II XLT, AT, OD, AC, AM/FM cassette, red and tan, take over payments. Morton, 296-6108.
- '75 DATSUN 710, new tires, battery, starter, and clutch, \$750. Reiser, 294-0691.
- '82 19' BAJA BOAT, 200-hp Mercury outboard, open bow, seats 8, new travel cover, trailer, \$9000. Brown, 897-1948.
- '77 CHEV. C-20 CREWCAB PICKUP, 454 V-8, AT, AC, PS, PB, recent transmission overhaul, new HD radials. Beck, 865-6137.

REAL ESTATE

- 3-BDR. HOUSE, Blue Water Lake, Thoreau area, private, on 6 fenced acres, 2-1/2 baths, basement. Crawford, 299-0260.
- MOBILE HOME, close to Base, 60' x 12', partially furnished, covered carport and patio, outside storage, extras, \$10,000. Bear, 881-7128.
- 2-BDR. MOBILE HOME, Cedar Crest, 1983 model, 1-1/2 baths, vanpool to SNLA available, \$16,500 OBO. Helling, 281-5536 or 294-0582.
- 4-BDR. HOME, 1700 sq. ft., near Eubank and Menaul, 1-3/4 baths, den, assumable FHA loan, low down. Simpson, 296-6757 or 299-7998.
- CUSTOM HOME, 2500 sq. ft., in foothills east of Tramway. Gallegos, 296-4738.
- 3-BDR. TOWNHOME, Academy Hills, 2 baths, great room w/vaulted ceiling, 1510 sq. ft., w/all appliances, \$99,800. Clauss, 821-8840 or 266-9319.
- HISTORIC-REGISTER ADOBE HOME, 6000 sq. ft., restored, 127 yrs. old, separate shop/studio, 1.25 acres, Belen, \$198,000. Pollard, 1-864-2795.
- 2 ACRES, east of Albq., gentle southward slope, water and electricity available, \$14,500 or terms for SLFCU member. Rodriguez, 294-2212.
- 3-BDR. TOWNHOUSE, 2 baths, double garage, assumable loan w/cash to loan, or cash plus REC, \$105,000. Campbell, 275-0789.

LOST AND FOUND

- LOST: MAN'S GLOVE, black leather, size 8, left hand, lost in Bldg. 802 first floor area in the south wing approximately Jan. 15. Asher, 299-1668.
- LOST: "ARIS" NECK SCARF, grey-brown color w/pink, violet, white, grey, black design interwoven throughout, tassels, approximately 10" x 46". Anderson, 296-3352.

My Funny Valentine — and Yours — Get "In the Mood" Tomorrow

"IN THE MOOD," "Tuxedo Junction," and a lot of other golden oldies are featured by Don Lesmen and his group when Valentines get together tomorrow night to celebrate the February biggie. This heartily recommended special evening starts out with a buffet, served from 6-9 p.m., featuring baron of beef or mahi mahi, with a full salad bar. The dancing goes from 8-11:30. Reservations recommended (265-6791).

WHOOPIE TI YI YO, get along little dogies! Where? Right on over to the C-Club corral, that's where. Two big Western Nights are on tap. Tonight, following the two-for-one special dinner (filet mignon or scallops, \$14.95 for two) you can wing it to the tunes of the Western Flyers from 8 p.m.-midnight.

Next Friday (Feb. 20), those good old Poor Boys from Isleta gallop in to the big city to play their special brand of sagebrush-shuffle ditties for dancing. Before you hit the ballroom floor, eat all manner of goodies from a buffet featuring BBQ ribs and chicken, along with a full salad bar. Can't find a better deal for just \$6.95/person. Remember, chuck wagon tickets for both nights should be reserved in advance.

THOSE SHARP SCHUSSERS are at it again, with a full schedule lined up for February. Coronado Ski Club members have two more trips this month: Monarch (this weekend) and Crested Butte (Feb. 22). In between, the monthly meeting on Feb. 17 at 7 p.m. features talks and films on Utah ski areas. Then there's the Big One coming up on Feb. 28-March 1 — Carnival 87, an outing for the whole family at Sandia Peak. Carnival this year features races, treasure hunts, and lots of good food. Join the CSC and enjoy!

T-BIRD CARD PLAYERS celebrate February

with a heart-to-heart (and spade-to-spade?) shuffle and deal session on Thursday, Feb. 19. The action starts at 10:30 a.m., and we guarantee there's no under-the-table dealing when the group gets together! However, our informants tell us this intrepid bunch is working on a can't-lose, beat-the-dealer strategy before its next trip to glittering, glitzy Vegas.

NOTHING COULD BE FINER than to be in — not Caroliner, but the C-Club — when it serves that famous Sunday brunch. Your next golden opportunity is Feb. 22 from 10 a.m.-2 p.m. Here's a real meal deal — don't pass it up. For only \$5.95 (half price for kids under 12), brunch includes a BBQ entree, baron of beef, scrambled eggs, bacon, hash browns, green chile, a vegetable, salad bar with all the trimmings, fruit juices, and desserts. The whole family enjoys, and somebody else does the cooking. Don't forget to reserve your space.

WHAT'S SMOOTH, RARELY CROWDED, and surrounded by wind screens? If you guessed the C-Club tennis courts, you're absolutely right. An added bonus this year — scheduled for completion by the end of March — is lighting so you can hit the court (and the ball) after sunset. This fine facility is all yours when you join the Coronado Tennis Club. But don't delay — membership passes for 1987 are now on sale, and fees will not be prorated. Call the recreation office (844-8486) for membership forms and info on yearly fees. You'll be surprised by the reasonable prices.

LATIN FEVER hits the Club two weeks from tonight (Feb. 27), when freewheeling Freddie Chavez and his group belt out those charming cha-chas for your dancing pleasure from 8 p.m.-midnight. Beforehand, enjoy the two-for-one special featuring

filet mignon or snow crab.

WHAT'S NEW? A lot, if you take the time to check the trip agenda planned by the C-Club Travel Committee. Some of the offerings:

Hill Country — Texas hill country, that is. You'll explore it as part of a sojourn to San Antonio (March 15-18). On the schedule are a full day of sightseeing in SA, including a stop at the Lone Star Brewery — an experience you won't have every day; and the hill-country tour (including the LBJ Ranch, Fredericksburg, and Kerrville). You stay in downtown SA at the Menger Hotel, just minutes away from the Alamo and the Riverwalk. We thought the Green River was up north, but it turns out there's one in San Antonio too — at least on St. Patrick's Day! For \$421/person you get RT air fare, three nights' lodging, some really special meals, and a chance to laugh at Irish Texans.

Mountain Country — And river country and spectacular-scenery country. It's all in store when you sign up for an Alaskan adventure set for September. This never-to-be-forgotten experience in our largest state has it all: Mt. McKinley National Park, city tours of Anchorage and Fairbanks, a stern-wheeler cruise, and a one-week cruise on the magnificent *Regent Sea* if you opt for the cruise/land package (Sept. 8-20) at \$2325/person, double occupancy. Cruise-only types join the rest of the merry travelers on Sept. 13, just in time to board the ship at Whittier. (The latter option costs \$1642, double.) Cruise ports of call include Ketchikan, Juneau, Skagway, and Vancouver (the last stop, from which you'll fly back to Albuquerque). Included in the tab are all transportation (land/sea/air), lodging along the way, all meals on board the *Regent Sea*, and taxes/tips. Price breaks available on triple and quad occupancy, and final payment isn't due until July 20.

Fun & Games

Squash — The New Mexico Squash Racquets Association will hold its fourth annual D/Novice Squash Tournament Feb. 27-March 1. Beginners, first-time players, and rusty former-players are encouraged to participate in this just-for-fun event. For more information, contact the tournament director, Dave McTigue on 256-1752.

* * *

Golf — The Sandia Women's Golf Association will hold its annual membership sign-up party on March 4 at the Coronado Club Eldorado room, at 4:45 p.m. Membership is open to Sandia and DOE employees, retirees, dependents, and contract personnel.

* * *

Boating — The U.S. Coast Guard Auxiliary begins weekly classes in boat handling and safety for power-boating and sailing at 7 p.m. on Feb. 18 at the Armed Forces Reserve Center (400 Wyoming NE). There is a small fee for textbook and supplies. For more information, contact Carl Boxx on 299-2855 or Earl Livingston on 298-5926.

Congratulations

To Debbie (3523) and Andrew Gonzales, a daughter, Kristen Marie, Jan. 12.

Sympathy

To Al Iacoletti (2614) on the death of his father in Albuquerque, Jan. 20.

To Andy Oravec (2833) on the death of his brother in Pennsylvania, Jan. 31.

To Orval Tally (3424) on the death of his mother in Albuquerque, Feb. 4.

No More Breaks, Please



I was chasing our 160-pound Great Dane around the den. Our other dog, a 70-pound Heinz that considers "play" to be her own personal and unique possession, ran between my legs to indicate her desire to participate. I was launched into a sub-orbital, parabolic trajectory leading to an aerodynamically unstable descent, terminating in a suboptimal touch-down on a nonyielding surface. Both dogs thought it was the neatest trick I had ever done.

Maj. Ken Allison, *Focus*



VP ART DAVIE (3000) led an informal discussion on issues of concern to women staff members at a recent luncheon sponsored by the Women's Program Committee. Here, Art and Ginger Wilkinson (6431) share ideas before the program starts.

Confidence, Can-Do Capabilities — And Constraints

Editor's Note: This "State of the Labs" message marks the end of Irwin Welber's first year as President of Sandia National Laboratories. He and Executive VPs Orval Jones and Lee Bray were interviewed by members of Public Relations Department 3160. This series of articles is a condensation of that interview.

SLN: Mr. President, let's start out with a very general question. You've been president since last February and "president-elect" before that. What are your reactions to the year? What were the highlights and low points?

Welber: One of the things, of course, that caused me to feel the greatest amount of regret — or maybe the word is concern — was the departure of George Dacey. Of course, if George hadn't left, I wouldn't be here. So it's kind of a good news, bad news story. But George's departure left quite a hole that is impossible to fill. I did have the opportunity to work with him for about four months, and that was really very valuable to me.

The other thing, of course, is the loss of Tom Cook, who retired recently. That left a big gap in Sandia experience and tradition. But, of course, time marches on, and we have to face these things. And most recently, Charlie Winter and Jack Wiesen retired, so that experience built up over the years is leaving us, and we're going to feel it.

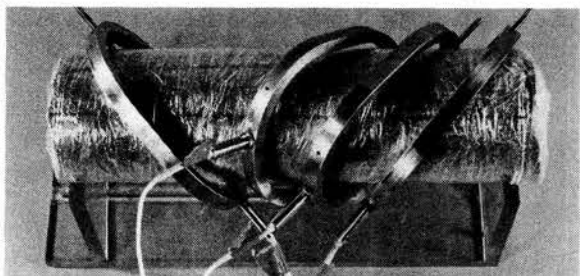
However, the other side of that coin is the replacements for these folks. Orval Jones has replaced Tom, and I think he is going to be an excellent replacement. Likewise, Arlyn Blackwell, Ron Detry, Ed Barsis, Larry Bertholf, Bill Alzheimer, and Heinz Schmitt and, more recently, Bill Snyder and Dave McCloskey, are going to do well in their new directorate slots. And, of course, there's the recent promotion of Roger Hagengruber to fill a new role, and Everet Beckner has gone over to the weapons side of the business, and Dan Hartley has taken over energy. These are moves that are good for the people and will strengthen the organization. We're going to continue to be a very strong laboratory despite the loss of some key people.

SLN: How about some 1986 technical accomplishments that stand out in your mind?

Welber: We achieved recognition by winning six awards in the competition sponsored by *Industrial Research* magazine; that's a recognition of our prowess. Gus Simmons won the E. O. Lawrence Award, another recognition of outstanding contributions in an important field.

And there were some really fine accomplishments in the energy area. For example, there's RAPRENOx; that's potentially a most significant accomplishment and one that reflects positively on the entire combustion research effort at Sandia Livermore.

We worked very closely with oil drilling companies on the anelastic strain recovery technique. That piece of work by Larry Teufel [1542] and his colleagues is a real boon, I think, to making oil drill-



SET OF METALLIC HOOPS is a tool for measuring *in situ* stresses in rock. Each of the hoops serves as a frame for a strain gauge that can detect movements as small as one-millionth of an inch. By positioning the hoops at different angles, Sandia's Anelastic Strain Recovery technique can be used to take detailed three-dimensional readings for better siting of oil or gas drill holes. The rock core is plastic-wrapped to prevent evaporation of moisture.



SANDIA'S TOP MANAGEMENT (from left): President Irwin Welber and Executive Vice-Presidents Lee Bray and Orval Jones.

ling more effective — it's a piece of scientific engineering technology that's really enhanced the oil patch operation by telling drillers how to structure their drilling geometry.

Jones: Another success is the work of Barry Granoff [6254] and his folks: their use of catalysts to reduce the temperature/pressure requirements for coal liquefaction. That could be extremely important in terms of the energy costs to convert coal to liquid fuel.

SLN: Let's not forget research. We've won some awards there this past year too.

Jones: I've been very pleased with the BES

Even though our primary emphasis is engineering, our research and support are really second to none. —Jones

[Basic Energy Science] awards that we received in 1986. They suggest that, even though our primary emphasis is engineering, our research and support of those engineering functions are really second to none. For the last several years now, our research has been singled out in a number of areas, far disproportionate to the size of our program compared to others elsewhere. In fact, in the last four years, we've gotten more BES materials science awards than any other group, and we've received a third of all BES "new initiatives" awards in the two years since that program began. I know people in 1000 are very pleased, and they ought to be. It's a nice recognition of the fact that applied research, directed research, can be excellent research.

Welber: We should also mention Division 8353's "hydrogen match" — using a catalytic igniter to prevent explosions caused by excessive hydrogen in a nuclear power plant. Some good work there by Sandia Livermore.

Jones: In a facilitative sense, I'm pleased that this past year we brought our interactive Cray Time-Sharing System on-line in our computer complex. It was a tough job, but it's operating now, and people are eager to get to the big problems that need to be solved. I think one of the hallmarks of our Labs and our sister labs is computational capability. It gives us a real competitive edge in quickly solving complex problems involving a lot of variables.

 LAB NEWS

SPECIAL ISSUE
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SLN: Gene Reed [former VP over the computing organization] said before he retired that he felt Sandia was a little bit behind in its computational capabilities. Since then, we've installed Cray X-MPs and done some other upgrading. Are we now where we need to be?

Jones: I think we're about where we'd like to be right now. That didn't come free, however; we've put in 8 to 10 percent real growth in funding per year for four or five years. That's caught us up rather well, so we've throttled back a bit at this point. We'll need to maintain a fine balance between keeping up with what's affordable and losing ground in capability.

SLN: Hasn't Sandia positioned itself for increased strength in creating new systems — expert systems, robotics, etc. — in hardware and software, systems that draw on existing systems for their design?

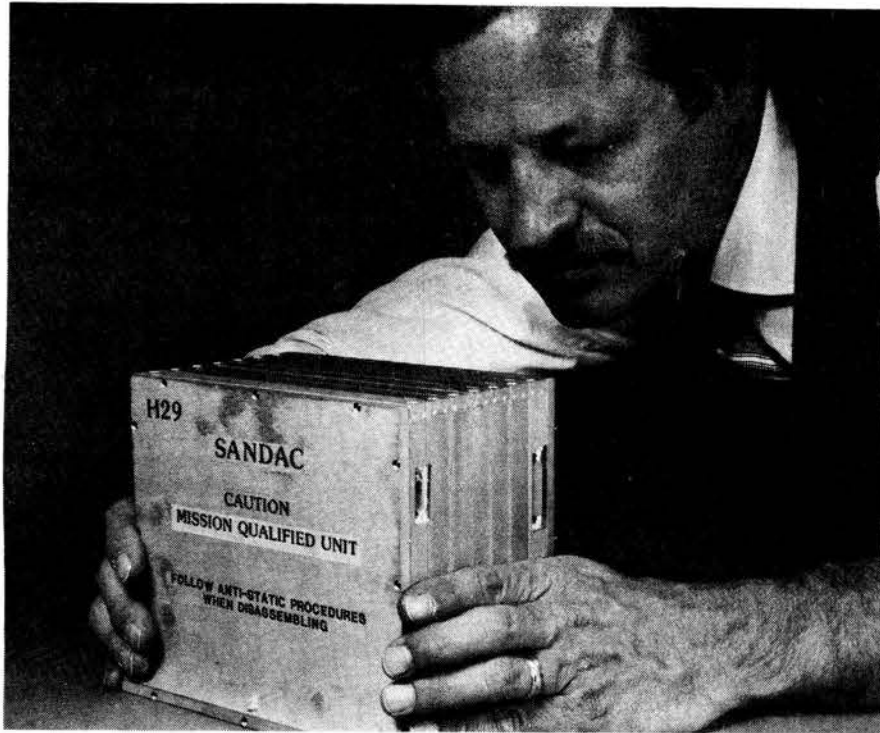
Welber: Yes, and the new directorate [Computer Science and Mathematics 1400] is a major step toward improving our research capabilities in this field so that we are indeed strengthening across the board. And SANDAC — SANDAC [SANDia Airborne Computer] is an example of a piece of hardware we've created that's a real achievement.

SLN: That brings up exploratory development, such as SWERVE [Sandia Winged Energetic Reentry Vehicle Experiment], which uses the SANDAC. In last year's "State of the Labs" interview, Tom Cook labeled SWERVE a "technological Maypole" that serves as a focus for developing several sophisticated technologies. Any major tests in 86?

Welber: No, but there will be some in 87. And SWERVE continues to show promise. It's a vigorous exploratory program. NASA has shown a great deal of interest in the SWERVE concept as an aero-

(Continued on Next Page)

SANDAC V, a 20-lb. candidate for the brains of "smart" airborne weapon systems such as SWERVE, is taken out of the proverbial shoebox it can fit into by technician Don Johnson (2336). The small-volume computer is a fast one: able to carry out 40 million instructions per second, a capability equivalent to a Cray 1-S.



(Continued from Preceding Page)

dynamic vehicle for futuristic space flight, and the NASA people have adopted some of our designs and are going ahead with their own versions.

The value of SWERVE is that it's a test bed for applied research and advanced development. —Jones

Jones: And that's natural — it's a unique design toward a high-performance maneuvering vehicle. The value of SWERVE is that it's a test bed for applied research and advanced development. In terms of accomplishments, there were some very interesting developments last year in optical processing of radar returns versus digital computer processing.

SLN: So it's an advanced kind of applied artificial intelligence?

Welber: It's a technique for taking the radar signal that is received by SWERVE and processing it, using optical technology. If you do it optically, you

end up with an image you can analyze very effectively with a minimum of hardware.

Jones: So, indeed, SWERVE is a kind of test bed for a high-performance vehicle. It's a very powerful test bed for pushing technology forward.

SLN: Are we doing pioneering design work in integrated optics?

Welber: We're doing some of our own work, but you'd find the advanced research in places like Bell Laboratories or IBM or TRW, maybe some of the other weapons labs. Basically we're adapting what is available to our needs.

Jones: One of our strengths, of course, is integrating new combinations of existing devices to accomplish a task — new combinations with special emphasis. Again, when you've got a test bed like SWERVE, as opposed to just an optical bench, you're motivated to build something in the right volume and the right weight, and that process causes big jumps forward.

Welber: It demands discipline, and that's good.

Sea Lance & 'Level-of-Effort'

Cancellation with a Bright Side

SLN: 1986 was the year in which we learned that the Sea Lance program was not going into Phase 3 [the detailed design and development phase that precedes production]. What are the implications of that cancellation?

Jones: Well, of course, we are very disappointed. It was, technically, a very demanding job, and we'll miss the challenges it posed. Nevertheless, I'm pleased to say that we'll be able to carry forward a lot of Sea Lance technology into future systems.

SLN: From a managerial point of view, losing a planned-on program like Sea Lance is obviously a challenge. Just as obviously, we didn't have to lay off the people who were working on it. What did we do?

Welber: That is the strength of being a DOE national weapons laboratory. We operate on a level-of-effort basis, so the folks who were working on Sea Lance are now beefing up other programs where we were short on manpower. So we've taken the disappointment of Sea Lance and, because we have a level-of-effort operation, turned it to some advantage by applying those talents to other important programs.

SLN: Define level-of-effort, please.

Welber: It means we do not oscillate, we do not vary our work force based on the specific jobs we have. The DOE funds us at a certain level of effort — level for the year.

SLN: As opposed to other government funding mechanisms: cost-plus-fixed-fee or funding for specific projects — the projects disappear, the funds disappear.

Jones: We can shift our balance between our committed workload and our advanced develop-

ment activities. If we have a heavy committed workload, we do less advanced development and vice versa. That doesn't mean that no one is perturbed by cancellations — people who worked on a program sorely feel the impact. But on, say, a directorate scale, the flexibility is there to move back and forth between those activities.

Irwin, at one of our Small Staff retreats a couple of months ago, we concluded that perhaps the Phase 3 workload is going to be a little lower than it's been in the past. That's not necessarily bad, because, in fact, we've neglected advanced development, or at least had it on the back burner, for some time now.

Welber: That really is the virtue of the level-of-effort concept supported by the DOE. That is, in the short term we don't vary the size of our organization because programs wax and wane; and, of course, they will wax and wane — it's the nature of R&D. When we do have a period when we don't have as many committed programs as we have had in the past, we can take that opportunity to refresh our technology base and create some of the new ideas that will give rise to the systems of the future. I think that's the strength of working with a sponsor who has confidence in our ability to manage under these circumstances and to create good technology during these periods.

SLN: You don't see the possible ebbing of Phase 3s in the foreseeable future as being a threat?

Welber: Not in the short term — two or three years. If we have a period of a decade or more of minimal Phase 3s, that's bound to have an impact on us.

SLN: We don't want to forget weapons. What was our most significant achievement there?

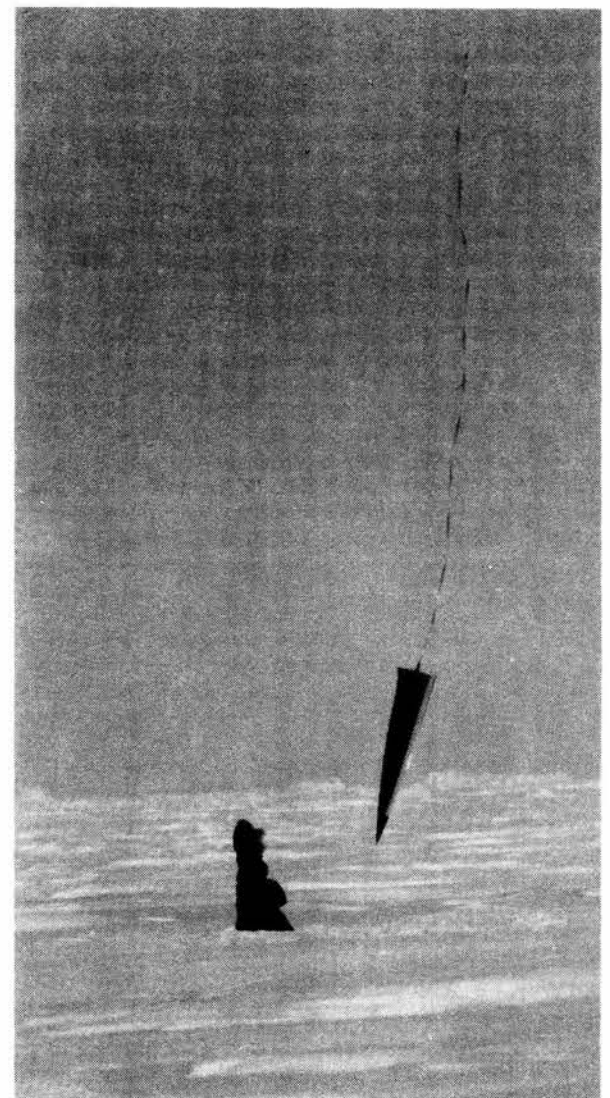
Jones: The W87 [Peacekeeper warhead] is now going into the stockpile. We successfully accomplished that task on a demanding time schedule in order to meet a national priority date. And the task was one that demanded very close coordination with the production complex to get the design successfully transferred and built. I think we did a fine job on that.

SLN: Is it still true, even with new weapon systems going into the stockpile, that the stockpile as a whole is not getting larger — that, in fact, the total yield is down?

Jones: Yes, and the primary purpose for replacing old weapons with new ones is that the new ones are more sophisticated in terms of safety and of command and control, and just as reliable.

Welber: In a weapon-related area, penetrators are now attracting a lot of attention, becoming high priority in discussions of new weapons, mainly nuclear.

Jones: Yes, in the past year we made a major advance in penetrator technology — we demonstrated, in full-scale sizes, the stability of penetrators of small aspect ratio. In other words, they're now short



TARGET LOOKS LIKE A PERSON — but it's really a parka draped over a stake. Sandia has conducted extensive tests of both the long, skinny and the newer short, fat penetrator designs. This test is on Arctic ice north of Prudhoe Bay, Alaska.

and fat as opposed to long and skinny, which was the conventional wisdom. We've found that short penetrators can be stable. And that discovery is very important in terms of packaging.

SLN: To what do we attribute this advance in knowledge? New materials, better testing capabilities, modeling?

Welber: The latter — codes, simulations. Most important, understanding the physics.

SLN: What can we say about potential uses of penetrators?

Jones: Penetrators can be used for attacking targets, implanting sensors, measuring ice thickness, implanting probes on Mars — a whole range of interesting applications.

SLN: Let's finish our discussion of technical accomplishments with a mention of the ICF [Inertial Confinement Fusion] program. It seems to be pro-

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ceeding apace, to pun slightly. Is it getting the funding it needs?

Welber: We got a little less money than we wanted . . .

Jones: But a little more than we expected.

Welber: So we're pleased. We were recently briefed by Bill Brinkman [1000] and Pace Van-Devender [1200], and I came away realizing once again that the program is a *tour de force* in terms of

physics. I think the people in 1200 have made tremendous progress, and I think the DOE is pleased with what's been done. The program continues to show good progress — and to pose tremendous challenges.

SLN: Related to that, is there not some synergy between the particle beam fusion area and the microwave business?

Welber: Perhaps so, but it's too early to say

much. Let's just say we're developing some interesting new concepts in the microwave area.

Administration: JIT, TLC, and ECP

SLN: So far we've mentioned only technical accomplishments. How about some from the administrative side?

(Continued on Next Page)

Close Enough to See Their Taillights

AT&T, Bell Labs, and Sandia

SLN: Mr. Welber, after serving in management at both labs, what do you see as the major differences between Bell Labs and Sandia?

Welber: I think there are really more similarities than differences. The similarities, of course, derive from the people. Sandia and Bell Labs hire in very similar disciplines from the same kinds of schools with the same kinds of standards; both labs offer educational programs that are very similar. So it's not surprising that you end up with similarities — quality of the people, their dedication to work, and their commitment to excellence.

The numbers are different — Sandia is maybe 40 percent of the size of Bell Labs. The other difference, and it has an impact, is that Sandia has two major locations, Livermore and Albuquerque. But Bell Labs has nine or ten major locations at which there are 500 or more people, thousands at some locations. And these major locations are separated by hundreds or even thousands of miles. That creates a different climate between Sandia and Bell Labs.

SLN: And among the major Bell Labs locations?

Welber: Yes. Each of those locations begins to have a character of its own insofar as identity is concerned. It's like Sandia Livermore. They have a real feeling of *esprit de corps*.

Bray: Even with a post-and-bid system to advertise job opportunities, Bell Labs is more restrictive in that an employee often has to make not only a career decision but a family decision — “doesn't that new job mean relocation?” Our people don't have to consider that element nearly as often.

SLN: Would you characterize the management styles as similar? We have consciously tried to adopt the Bell Labs management approach, have we not?

Welber: Well, yes. The structure, the levels, the names aren't the same, but, by and large, it is quite similar.

Bray: I think Irwin is right that we're much like Bell Labs. But I would go on and say “of yesterday and today — but Bell Labs is probably at the threshold of undergoing the most significant change in its entire history.” So, given that we have been very much like them up to this point, it raises an interesting question: “What will we do as they change?” I think that will be an issue for us.

SLN: Doesn't form follow function?

Welber: If their function starts departing from what it used to be and our function does not, clearly we must follow the appropriate style to suit what we have to do. And we will.

Bray: Their business is different from our business, and it's going to raise an interesting question: “Do we continue to follow their practice, or do we continue to have to make some challenging decisions about more deviations than we have traditionally made?”

It's going to be interesting for all of us. We don't have a preconceived notion how it's going to come out.

Welber: Ian Ross [President of Bell Labs] would say, “We have our mission, we have our goal, we're continuing right down the road.” But the environment changes, and sometimes you've got to change with the environment.

SLN: We've got a contract renewal coming up in 88. What is AT&T's attitude toward continuing to operate Sandia?

Bray: The clock has started; we have received a letter from DOE asking us for our intent. And the Sandia Board of Directors has met and discussed it at length — trying to view it both from a Sandia and from an AT&T perspective. I think there's reasonable agreement that AT&T ought to renew the contract. It's my feeling that Tommy Thomsen [Sandia board member and President of Technology Systems Group, AT&T Technologies, Inc.] and those who will carry the ball forward to the AT&T chairman plan to go with a positive recommendation.

SLN: So at this point, we see no reason to believe that some other company would become our parent company.

Bray: True. The only reason to believe there could be is that AT&T is having to reassess everything it's doing. Naturally, then, we get swept into that reassessment. So the opportunity for AT&T to change its mind about operating Sandia is maybe greater than it was in the past. But we're optimistic that the decision is going to be a positive one.

Welber: And we're desirous that it be.

SLN: Under the current terms of the contract?

Bray: Our view is that we want to maintain the contract as it is — as nearly as possible.

Welber: No fee, no profit. Some people call it a treaty.

SLN: We mentioned following the AT&T lead when we talked about technology transfer [see main story]. Might we not see other changes at Sandia related to changes occurring within AT&T? In other words, how closely are we going to continue to follow the lead of the parent organization?

Bray: First of all, I think we have to be sensitive to the fact that in the past we have used that lead to maximum efficiency at Sandia. Second, it's a reasonable requirement of the contract that we pattern ourselves after AT&T and Bell Laboratories. If you look hard at the contract, you might be able to find ways that permit deviations — there are some qualifying clauses and so on. But our management strengths come from AT&T and Bell Labs, and we have indeed patterned ourselves after them.

For example, we made a tough decision a year and a half ago to follow them through a period when our salary package was not as large as we would have liked. After all, it doesn't stand us in good stead to say, “The first time they do something we would rather not do, we won't follow them.” We could do that, of course, but the next time that we would want to follow their lead in something very positive for Sandia, we'd be closely questioned.

SLN: Let's be more specific. What is the 14-level plan, Lee, and how will it affect us?

Bray: It's a series of levels within the administrative side of the house — from MLSs through Directors. We now have some 20 levels — five MLS “bands” plus 15 more steps or point bands in the supervisory ranks. Many of those overlap, of course, so the 14-level plan is more a re-packaging than a departure from our current practice. Some AT&T organizations had as few as six lev-

els; others had as many as 86.

I'm really convinced the new plan will have a positive effect on Sandia. It doesn't change substantively anything we're doing now, and it represents one of those changes where I think it would be a mistake for us not to follow AT&T. I think most folks would agree that it's the right thing to do; they just need an opportunity to get used to it.

SLN: What will it buy us?

Bray: It will ensure pay equity across all of Sandia's and AT&T's administrative employees, management, supervisors, and MLSs. Our MTSSs, incidentally, are already on a comparable scale with other AT&T organizations. Perhaps most important, it will facilitate a flow of people to and from Bell Labs, other AT&T groups, and Sandia, and we believe that such transfers can be highly beneficial to the organizations and to the employees involved.

I also think that, in our salary administration program, we are going to have to pattern our percentage increases and perhaps our final pay positions pretty much after them. But if we have a completely different structure and number of levels, I don't know how we can do it.

Then there's the philosophical viewpoint: What would be a defensible rationale for our being different? How would we justify saying, “We followed their lead in getting to where we are but then just arbitrarily chose not to follow it later?”

Welber: There are other areas that we're discussing now. Bell Labs has gone to lump sum awards [a monetary recognition of outstanding performance, but not part of base salary], and those are very tricky. If they continue to have lump sum awards for five or ten years in a row, and their compensation is based on the amount of lump sum awards plus salary and we pattern ourselves after their salary, we're going to find our salaries going down as AT&T increases the “amount at risk,” as they call it.

Bray: You know, your first reaction to a lot of these changes is “That can't be any good for us. Let's don't do it.” The trick is for us to understand which ones will be inherently good, and which ones will be good in our environment. Those that are neutral I say we ought to adopt because that keeps us alike. Those that are bad for us? Those we have to be wary of.

My attitude is that, when they make a change, we're going to review it with a bias toward following it. That is, we're going to examine it carefully to see what the implications are if we do follow it. And if it turns out that it has significant negative aspects for us, then we're going to take a very cautious approach. AT&T, of course, would want to understand why we're different, why it's more damaging to us than it would be to them. We must choose those deviations or those exceptions carefully.

SLN: Bell Labs and AT&T are changing rapidly and of necessity. We are not driven by the same necessity.

Bray: But we need to continue to follow their practices where appropriate. In this time of dynamic, rapid change, we're saying we're going to follow them close enough to see their taillights but not so close we hit all the same chuckholes.

Welber: I think a rather critical one is our award for placing purchasing contracts with small businesses.

Bray: Yes, we received an award of excellence from DOE for our efforts in developing and utilizing minority-owned small businesses in our procurement process. Dick Russell [3700] and Jon Bedingfield [3731] went to Washington to accept the award for Sandia.

SLN: Irwin, you said a year ago that one of the things that impressed you about Sandia was that people on the administrative side of the house were real players in getting things done.

Welber: Yes, and I still think that's true. An example is the RAPRENOx press conference. It was clear that it was done professionally and resulted in

86 [was] a year of significant accomplishment in the administrative side of the house. —Bray

excellent coverage in the press on both the East Coast and the West Coast. Good television coverage too!

Bray: Speaking generally, I consider 86 a year of significant accomplishment in the administrative side of the house. By that I mean the organization itself, the new people we've hired, and the mentality that we've adopted towards excellence, towards strategic thinking and planning. I think we're beginning to recognize that we've got all the resources we've ever going to have, and yet we've got to be doing more things than we currently do. So that means we have to understand how to free up resources and talent to get them directed to those new things that we want to address. I'm sensing that that attitude is being understood and accepted and that in fact there's some excitement about it — that we have the opportunity to control our own destiny: We can figure out what to do less of; we can do what we do more efficiently; we can free up resources to do the new things that we want to do. It's making us a more effective organization.

Jones: Certainly from the standpoint of the technical side of the house, I think the changes in Purchasing are very positive ones — in particular the buyer assignments by organizations as opposed to by commodity — and I think most people have a positive view of Just-in-Time.

Bray: That's one specific area. Another is the TLC [Total Life Concept] program. It's an excellent program, and it's been managed very well by Paul [Mossman, 3300] and his folks. I think it is having, and will have, more impact on us than perhaps we realize: Our "take" [involvement in the program among those invited to participate] from it has been about 65 percent. If you compare that with other companies and if you look at the fact that we were at one or two percent earlier — even though we had all the same elements — you realize that 65 percent is extremely good.

I think TLC is going to have untold advantages. We're going to have people who are feeling better about themselves; they're going to be feeling better, period; they're going to be more productive — it gives them a better sense about the Labs.

So it's been a very successful program, and those folks in Medical deserve a lot of credit, because it's easy to hype it and get it started and then not

Every Sandian who contributed ought to feel proud of our [ECP] achievement. —Welber

follow through. If you do that, it's deadly. Remember, it's a five-year plan — we divided the on-roll number by five and invite a fifth of our population to join TLC each year.

Welber: I agree. Let's keep the enthusiasm going.

SLN: Speaking of enthusiasm and success stories, how about the ECP campaign in 86?

Welber: I think every Sandian who contributed ought to feel proud of our achievement — we surpassed our goal, the highest goal ever; and we set new records for the average amount pledged per con-

tributor [\$183] and for the percentage of participation [89.2 percent], at least for the last five years. It was an exemplary achievement. A well-run campaign too; Bill Marshall [6250] and his committee deserve our thanks.

Funding for the Fiscal Year

SLN: How about bucks for 87? Are we happy, unhappy?

Welber: I think we should make it quite clear: We have weathered the budgeting cycle, and I think we are very fortunate in 87, considering the pressures to reduce this nation's deficit. Extremely fortunate. What will happen in 88, I don't know, but in 87 we have a good recruiting program. We're not going to grow, but we will keep up with attrition and add new blood. So 87 is a good year.

Bray: We talked earlier about the past year. One of the things we should take a moment to reflect upon is the Gramm-Rudman-Hollings curveball we were pitched a year or so ago. We had been looking at fairly significant growth during 86. In fact, it was probably going to tax our capabilities to recruit. Then, suddenly, we were facing a reduction of about \$30 million. Well, we wrestled through all that — and it's kind of interesting that we've forgotten all about it. It says something good about our budgeting system; that's another accomplishment for 86.

In fact, we ended up 86 just dead on. Couldn't have done a better job of budgeting, and if you look at us from Washington or anywhere else, we did very well. And we did it in what may have been one of our more difficult years of the last eight or ten, the good times. We need to remember that. Then,

We're looking at a lot of uncertainty in 88. I think we'll be fortunate to get level dollars in our main program areas. —Jones

as Irwin says, to be able to hang on to that budget level with the fiscal problems that the nation has says a lot about our reputation. We're expecting to continue to recruit at pretty much our normal rate, although there could be some modest adjustments because retirements aren't occurring quite as fast as we'd projected.

Jones: I would second what Irwin and Lee have said. I think 86 ended up in good fashion. But I think the experience sounded a clear note of caution for us. We're fortunate in that 87 appears reasonable.

SLN: How about 88?

Jones: We're looking at a lot of uncertainty in 88. I think we'll be fortunate to get level dollars in our main program areas.

Sandia's Mission, Current and Future

SLN: We have said often that Sandia's underlying mission is national security, and that as long as a nuclear deterrent is needed to protect the nation, our role is to provide it. Is that still an accurate statement?

Welber: Yes, at present. It really means that our primary task is to ensure the reliability of the stockpile, and we must never forget that. We continue to monitor, observe, and evaluate these weapons as they age — and some weapons have been in the stockpile nearly 30 years. So we have to understand every aspect of the aging problem and ensure that we make the policymakers and the armed services aware of what we learn. It's a very important mission, and it's not a simple one.

SLN: You said, "at present." What are you suggesting about the future?

Welber: Change. Continued change. There will be change.

And therefore, and to be more precise, we have to ask ourselves, "What will the national laboratories become if the nuclear deterrent is not the major centerpost for our defense policy?" As we think about that, we've got to consider our overriding mission to be, as you said, national security. And national security is embodied, not only in the stockpile, but in such things as the industrial competitiveness of

our key industries. It very well could be that the national laboratories could play a role in creating technologies that we would pass on to U.S. industry to make it more competitive. Collectively, we have the wherewithal to help because of our tremendous breadth. It's an effort that must be managed, must be motivated. And it must be recognized by our government — by the DOE, specifically — as a mission.

Jones: We must not let the thought of change worry us. Sandia can deal with change with confidence. After all, we've changed significantly over the last decade or so; we're a tremendously different laboratory than we were then. Then, we were a single-purpose laboratory. Now, we're a multi-program laboratory with a prime mission. We were Sandia Laboratories 10 years ago. We're Sandia National Laboratories now, and the range of technologies we're involved in has greatly expanded. That's why I find Sandia such an extremely exciting place to work — the range of job areas in which one can work is so great.

Those aren't the only changes. Twelve years ago, employees, in effect, had to talk their supervisor into

The best education you can ever get is when you're right in the middle of the soup and you have to learn. —Jones

agreeing to let them transfer to another organization. We now have a system in which employees can move readily. It's a tremendous enhancement of the continuing education of our staff — the best education you can ever get is when you're right in the middle of the soup and you have to learn, as opposed to taking courses. The courses back you up, but the real education is when you're making something happen, applying that new knowledge to real work.

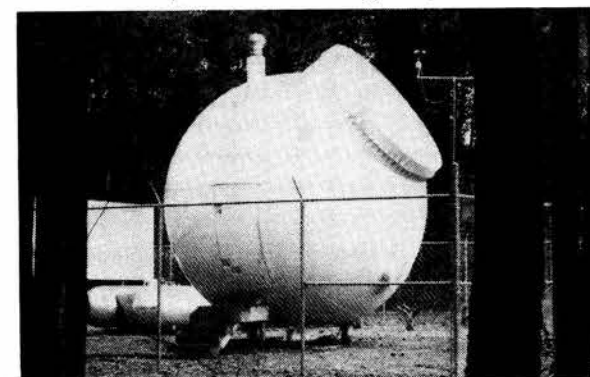
So we've seen really tremendous changes in the character of Sandia in just a few years. What this all means is that we're a lot more flexible than we used to be. And we need to preserve and expand the ability to be light on our feet. That makes us better able to accommodate whatever changes might come along.

Welber: It's so difficult to maintain a focused mission, so that you have an anchor, and yet be light on your feet, which I agree we have to be. But we must not become a job shop — end up doing a hundred different jobs for a lot of different customers — and not have a central focus. If we're not careful, it could happen, because our skills and our capabilities are really sought after.

SLN: Speaking of change, how would a CTB [comprehensive test ban] treaty affect us?

Welber: Whatever happens on a CTB is a political national-security issue. All we can do as a weapons laboratory is to make the people who make those decisions aware, in as straightforward and objective a way as we know how, of the implications of those decisions on the nation's capabilities for defense. That's been our job, and it continues to be our job. Our new 9000 vice-presidency [Exploratory Systems Development] is a testimony to that role; among other tasks, it is developing technical means to ensure that any arms control treaties agreed to are verifiable.

(Continued on Page Six)



NATIONAL SEISMIC STATION rests on the ground in the Adirondack Mountains of New York. The station network, located throughout the U.S. and Canada, was a precursor of a system by which a country could monitor the magnitude of not only earthquakes but also of underground nuclear tests. One of the major roles of the new 9000 vice-presidency is to develop such monitoring systems for the verification of international arms control treaties.

Multi-Program Lab Means Multi-Committee Structure

SLN: The new Sandia Programs committee structure [see chart] shows a set of internal program committees chaired by Lee. What's the primary task of all the committees, and how do they relate to each other?

Welber: These committees have a tremendous amount of responsibility. Their primary task is to allocate the available funding equitably and in such a way as to maintain and build the strengths — people, equipment, facilities — it takes to keep Sandia a major R&D institution, a primary resource for the nation.

Jones: The Internal Program Committees look to our internal needs and management issues. The Direct Program Committees look outside the Labs. That is, they relate to our funding sources, and, generally, they're program-, funding-, direction-oriented.

SLN: Over time, the number of committees has increased. Why?

Welber: The major driver here is that we've become a multi-program national laboratory. Once, nearly all our funding came from DOE's Office of Military Applications, so we didn't need the kind of committee structure we have now to manage well. But now, while we continue with our prime nuclear weapons mission, we have substantial programs funded by the NRC [Nuclear Regulatory Commission], DOE energy offices, and so forth. Multiple sources of funding almost mandate a multiple committee structure to find an appropriate balance between our resources and the work we're asked to do for others.

Jones: Under one roof, so to speak, we work on an enormous range of activities. And because we have expertise in so many areas, we're sought after by a wide range of funding sources. We're often asked to do more than our resources will allow. That requires some tough decisions.

SLN: How about a quick rundown on each committee?

Jones: Two of them, WAC and RAC, deal primarily with the Office of Military Applications. WAC is responsible for seeing that our committed weapon-development tasks are done properly. (Incidentally, this committee is headed by the Defense Programs VP and the Livermore VP in alternation; currently, the chairman is officially Everett Beckner, but, in practice, 5000 and 8000 serve as co-chairmen). RAC ensures the vitality of our tech base, which supports our ability to accomplish that weapon-development task, and our exploratory research activities, which prepare us for meeting new weapon challenges of the future.

EAC looks after the programs with which we support the DOE energy mission. It's concerned with such areas as solar, fossil fuels, nuclear power systems, our work for DOE's Basic Energy Sciences program (including the Combustion Research Facility and materials research), and our NRC research.

NSAC is concerned not only with reimbursable work for sponsors other than DOE, but also for DOE Defense Programs that do not directly involve nuclear weapons development. Areas covered by NSAC include reimbursable nuclear-weapon-related fuzing and test programs, safeguards and security, treaty verification technologies (both satellite- and ground-based), nuclear weapon survivability, international technology assessment, radiation-hardened microelectronics, advanced conventional military technology, SDI reimbursable work, advanced reentry vehicle

developments, pulse-power beam technology, and others.

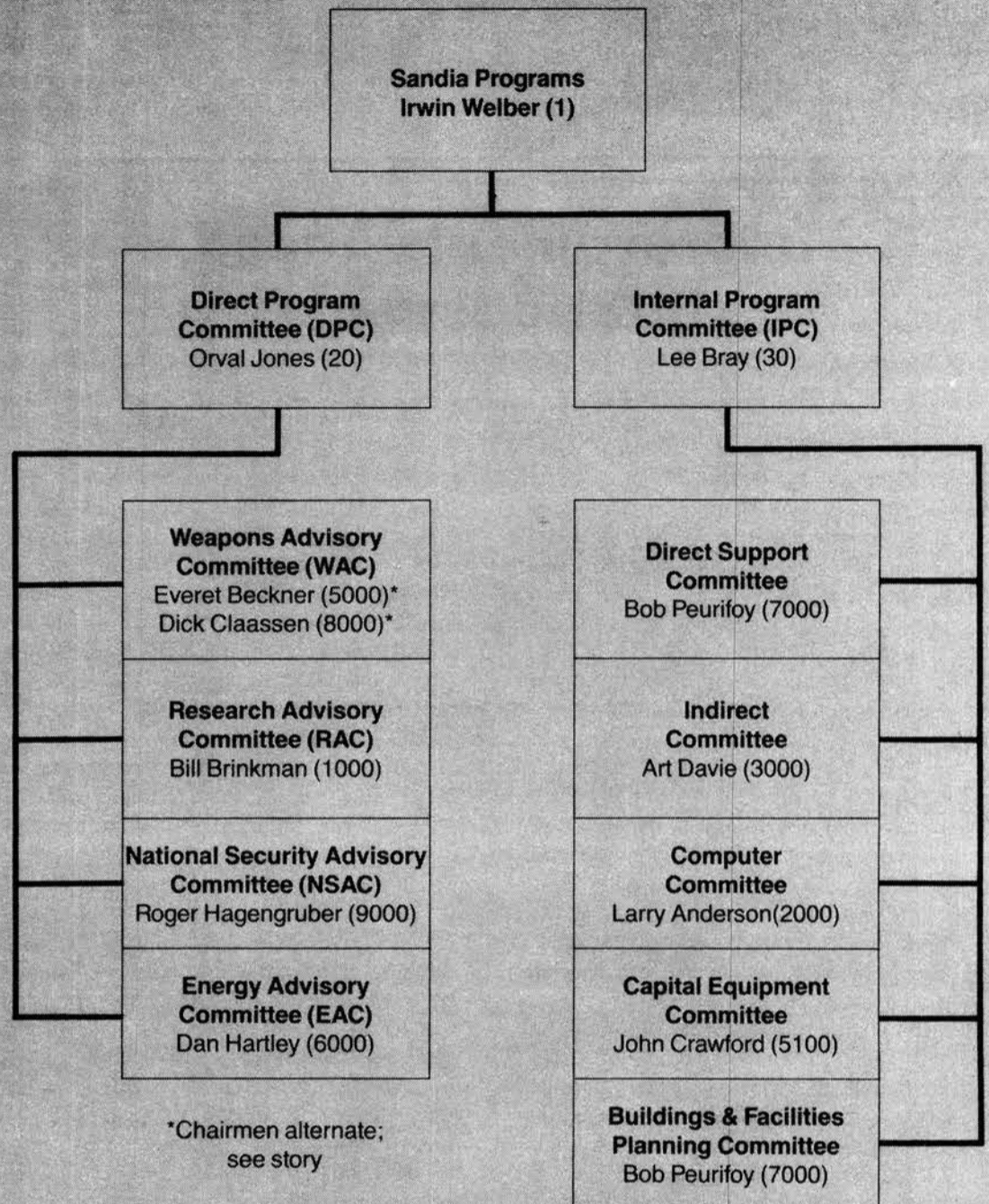
Bray: Doing all those tasks represented by the Direct Program Committee — and doing them efficiently — demands a strong internal support structure. The Direct Support Committee oversees a broad range of supporting activities — testing, drafting, development labs — that underlie our major programs. These functions, and others, are part of Sandia's "toolkit." The committee is charged with ensuring the continuity of support required to maintain our capabilities.

Another kind of support is less direct, hence the committee name, Indirect. To get our jobs done, to meet our obligations to DOE, to retain a well-qualified work force, and to be perceived as a desirable place to pursue a career, Sandia needs organizations such as Medical, Purchasing, Accounting, Property Protection, Benefits, Training, Information, and others — those groups in 3000, 100, 8020, 8260, and so on. They're represented on the Indirect Committee.

Jones: It's a tough job controlling indirect costs — but the Indirect Committee has done an outstanding job.

Bray: It has worked hard. The Computer Committee deals with a function that's absolutely vital to the tasks of nearly all of us. And it's an expensive function, focused in 2600 and 8200 but, increasingly, permeating all of Sandia.

Sandia is not just an analytical organization.



*Chairmen alternate;
see story

We do experimentation, and that's always equipment- and dollar-intensive. The Capital Equipment Committee allocates the funding available for equipment according to the needs of our various organizations.

And, finally, the Buildings and Facilities Committee has the task of providing our workplace for performing our tasks, both today and tomorrow. That can mean building new or modifying existing facilities.

SLN: What happens when the committees disagree as to where the dollars should be spent or the people should be placed?

Welber: Orval, Lee, and I do some discussing. Basically, we study the rationale underlying each conflicting proposal, and we resolve the conflicts as equitably as we can, keeping in mind the overall health of the Labs.

SLN: Obviously, each of the vice-presidents is involved in these committees. But where does Small Staff as a whole fit into the picture?

Welber: Small Staff continues to, let's say, run the company — policies, promotions, personnel, and so forth. It really sets our direction, based, of course, on the recommendations of each of the committees.

In the coming year, we're going to be putting on — in Lee's and Orval's words — our "corporate officers' hats" and taking a close look at strategic planning [see "Improvements Ahead"].

Jones: We don't know what will happen on the political level, but whatever happens will cover some period of time. And during that period of time, I think Sandia, through its job of weaponization of nuclear explosives, is going to be a kind of central focus because we're involved so intimately, as we said earlier, in the safety, the reliability, and the tailoring and adapting of nuclear explosives to new or different carrier systems. Regardless of whether things remain the way they are now or whether they change, there's definitely going to be a stockpile over some period of time, and that involves Sandia.

Welber: So, no matter what happens in the way of a test ban, our mission will be, as we said earlier, the stockpile — it has to be maintained, kept reli-

able, improved, tailored. So we'll be doing that. Now, that task covers only a part of a generation — 10, 15, 20 years. It's very difficult to project beyond that.

Jones: I think this is an area where our AT&T heritage stands us in good stead — trying to hire the most capable people we can on both the technical and the administrative sides. That constitutes a team, and I'm optimistic that the nation is going to have a place for that kind of a team regardless of the details of shifting priorities and evolving programs.

SLN: *There's still going to be plenty of creativity needed — for a CTB or for a more wide-reaching shift in mission.*

Jones: That's really the way I see it. As I said, we're a multi-program national laboratory now. We

were a single-purpose, highly focused laboratory before. Even though the future is always uncertain, I feel that we're very well positioned for it.

Welber: The broader your capabilities are, the more you can take advantage of whatever the nation's needs are. And our role is to serve the national security purpose: Make our country a better place to live — without competing with industry. We have certain constraints: We have to be unique, we have to offer something somebody else cannot offer, and it must be for the purpose of national security. But within those constraints, I think we have tremendous opportunity to serve the nation.

SLN: *That's a good-sized sphere in which a lab can operate.*

Welber: It's an even bigger sphere than we have now. And we must be selective as we undertake other activities beyond our main mission — the weaponization of nuclear explosives.

Matrix Management & Strategic Planning

Improvements Ahead, But No Nirvana

SLN: *Last fall at the Department Managers' Conference, the matter of matrix management [essentially, organizing a company on a matrix, with functions along the top and programs down the side] came up. We understand that this is something you're examining and that at the same time you're thinking about more strategic planning. What would you like to say about those two interrelated issues?*

Jones: The first thing I would say is that our system is perceived by our sponsors and customers as one of the best around. We're singled out as an example of good fiscal and program management.

But that's not to say that we can't still improve, and in my view this really boils down to communicating the consensus of intent that we want for our laboratory and then solving problems as they come up at the working levels.

SLN: *So how do we do that?*

Jones: First, I feel that management needs to pay more attention to developing a strategic plan for the Laboratories, and I view a strategic plan as having two dimensions. One is the program and activity dimension, and the other dimension is the capabilities that make us special and that give us our ability and our "can-do" reputation. And I think we can do a better job of understanding that and communicating it down the line. It provides a general guide for people when they're thinking about a piece of work they can do or how they're going to support some activity. Eventually, the whole business comes right down to the sub-case manager working with the division supervisor or project leader to get an increment of work done.

Invariably, there will be some mismatch, so in moving toward improved strategic planning, I believe we've got to develop a better way for understanding those mismatches — whether they're the normal amount that you would expect or whether they're excruciating — and feed that information back into the planning process to control the kinds of programs that we undertake, the capabilities that we build into Sandia, and how we size our organizations to get those jobs done.

Now, there are lots of steps in between that also can be improved, and the major committee chairmen and I are definitely thinking about them. The department managers are enthusiastic about helping us identify and solve problems; that's a very valuable input for us.

SLN: *What's the role of the department managers here?*

Jones: I see department managers as the fulcrum of this process: If something isn't working as smoothly as it should at the division and staff level, the department manager is surely going to hear about it; on the other hand, upper management, directors and above, tends to think of things in a more global fashion. So I think the interest by the department managers is very appropriate, and I'm looking forward to their help.

Welber: When I met with the department managers at their conference, I was made acutely aware of their concern over the process, and I sat down with Lee and Orval and said, "We've got to do something about this concern." I've since met with people on the committee that staged the conference. They feel that the problem is being addressed and are waiting to see progress.

However, the fact of the matter is that our matrix budgeting process has conflict built into it, and there's no way around it — unless we have more money than we can use, there will always be the problem of somebody's not getting enough and that means they're unhappy.

Bray: It's not just money. We often need more people, and that's what we can't provide.

Welber: That's right, but we refuse to allow ourselves to grow beyond a certain point, and that's discipline, that's adhering to a mission statement.

Jones: We have to recognize that we are a multi-program lab — and I think we're glad of it. As we look forward to the future, we know we're going to be working for many sponsors, spending dollars that are not interchangeable among sponsors. That means that budgeting is going to be a pain. There is no perfect system, but I think we need one that indicates the direction in which we're moving, and then provides a mechanism for feedback that tells us what the problems are so we can act on them.

As Irwin said, we will always end up with some unhappy people. We'll never have everyone feeling that they've achieved a state of Nirvana — everything perfect, everything settled. Tension is built into our multi-program responsibility.

SLN: *Case managers [Sandians who are responsible for project budgets but are not necessarily in supervision] seem to feel that the system is tilted away from them and needs to be tilted back. Is that true?*

Welber: Well, it's true they feel that way.

Jones: And organization managers feel that case managers are too dominant. How you feel depends on whose shoes you're standing in. But I know there are improvements to be made.

Welber: And I think there will be improvements, but I'm not sure there will ever be a perfect solution.

Jones: It's unlikely that we'll see the time when every Sandian says, "Wow, every last tenth of a man year came out just perfect, every organization is sized just right!"

SLN: *Shouldn't we expect that with the management team we've got?*

Welber: More seriously, if, having wrestled with it for some time and in some depth, the people involved cannot reach agreement, then . . .

SLN: *Then what?*

Welber: That's when I have to step in and make the decisions that can't be made by our matrix process. But I really hope we don't come to that.

A Look at the Near Future

SLN: *We've talked generally about our mission and how it could change — "blue-sky" stuff, if you will. How about focusing on the more immediate, and more predictable, future?*

Jones: One of our most important responsibilities is weapon safety, and we've started taking a fresh look at that. The Challenger accident a year ago January 28 is, of course, a vivid reminder that we must not become complacent or apathetic about safety, but our refocusing on safety really goes back to George Dacey's earlier question, "Are we farming as well as we know how?"

SLN: *What is Sandia doing?*

Jones: First, many of us have been reading the Challenger accident report, which is an extremely interesting story in itself — as good as any novel. I've been trying to sensitize people, both inside and outside the Labs, to some of the problems that were identified there. One of them is, "Just because it worked last time, don't assume that it's necessarily safe." We need to emphasize a careful, well-thought-out design review process aimed toward safety.

I've asked our safety organization and our weapons design organizations to take stock of how we resolve differences in opinion between those two groups. First of all, the design people must have the responsibility for "designing in" safety. We don't want an audit function in which somebody feels, "I don't have to worry about it because somebody else is going to check it; so if I miss something, it's OK, they'll catch it for me." The safety responsibility must rest directly on the designer; our safety organization serves as a conscience.

We have also reviewed our safety process in some detail. I'm particularly interested in how differences of opinion between the designer and the safety organization are resolved. I want to be certain that those differences don't end up as a letter in each organization's file. Rather, if a satisfactory resolution isn't achieved, the problem, in fact, must go up to the next level of management.

One of the important ways in which Sandia differs from NASA is that we have a "separateness" of our safety organization and our designers. As you recall, the two come together only at Irwin's level: Bob Peurifoy's organization up through Lee Bray includes the safety conscience. 8100 and 5100 up through me represent the design function. That wasn't the case at NASA — both functions were mixed together. So we're doing it right.

Nevertheless, an accident like Challenger makes you think, "Hey, let's step back and take a look to be sure that everything is working properly, and be certain we have a step-by-step procedure for resolving any differences of opinion."

Welber: With that in mind, we invited William Graham, the acting director of NASA during the Challenger incident, to be the speaker at last year's Large Staff Conference. He gave a very thoughtful presentation on his analysis of the environment in which that accident occurred. As Orval suggests, he emphasized the lack of separation between quality assurance reliability and operational responsibility.

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Bray: I'll be sharing some responsibility in the safety area too. As Orval pointed out, the "safety conscience" organization reports to me. Sandia, as an AT&T subsidiary, also has an obligation to protect its parent from potential liability. So when I ask myself, "Where are the AT&T vulnerabilities?" I have to conclude that they're in the safety/reliability area. AT&T enjoys, in a limited way, some of the positive reputation that Sandia has because of its tremendous design and development work. On the other hand, AT&T could certainly share a lot of the negative attention that Sandia would receive if there

I need to be satisfied that we really are doing everything we ought to be doing in safety and reliability. —Bray

were a problem. So when I put my subsidiary hat on, I realize that I need to be satisfied that we really are doing everything that we ought to do in safety and reliability.

I plan to spend maybe the bulk of my time on that side of the business for the next year or so. For me, it's a good time to take on this responsibility: First, I think the administrative side of the house, as I said earlier, is in very good shape. It doesn't need as much of my attention. Second, I've got an excellent opportunity — as Heinz Schmitt comes up to speed in replacing Jack Wiesen in Systems Evaluation [7200] — to have him drag me along, let me look over his shoulder, learn what he's learning, get a first-hand view of those safety considerations.

SLN: So both of you EVPs are coming at the same problem at the same time. What are you doing to promote increased individual responsibility to safety?

Jones: There's a revised Code of Conduct, coming out soon, that will again remind each individual employee of our basic responsibilities. For the first

The danger in all these issues of safety — personal, environmental, or product — are really complacency, apathy, and arrogance. —Jones

time, we've included a comment about our responsibility for the safety of our product as well as safety on the personal level. The dangers in all these issues of safety — be they personal, environmental, or product — are really complacency, apathy, and arrogance. You have to kick yourself every so often and say, "Now look, maybe I'm too comfortable; let's think everything through again."

Specifically, I intend to ensure that the answer to "Do we address safety as vigorously as we do the meeting of technical specifications?" is "Absolutely."

SLN: Any advances in safety within the weapons themselves coming up?

Jones: There is some interesting advanced work going on in optical firing systems. We've traditionally ensured safety through a combination of mechanical and electronic logic — in the parlance of a physicist, phonons and electrons. But the mechanical technology, the clockwork, ends up being really quite intricate and expensive. Looking to the future, we see the possibility of shifting to optical systems, so we'd still have two different kinds of logic, but they'd be electrons and photons. It'll be a few years coming, but such a system would continue to provide different physical properties to provide safety. We think we can shift from phonons to photons, while retaining electrons.

SLN: That shift would prevent spurious electronic signals from finding their way into the wiring of a weapon.

Jones: Precisely. That's basically the reason we use mechanical devices now.

SLN: How's our future in terms of weapon development programs?

Jones: It looks good. Two new Phase 2As — SRAM [Short-Range Attack Missile] II and SICBM [Small ICBM] — were assigned to Sandia Livermore last year. We're also doing a Phase 2A on the nuclear depth strike bomb in Albuquerque. All three won't necessarily result in Phase 3s, but the W82 artillery projectile is finally in Phase 4 at Livermore now, and the W88 Trident II warhead is in Phase 4 here.

And we may see a request for an Army tactical weapon on one of these days. It's going to be a busy year or two. The number of Phase 3 programs may decrease in the future, but we don't see that as an immediate cause for concern [see "Sea Lance and Level of Effort" story].

SLN: What can we say about our role in improving the command and control of weapons?

Jones: We've enjoyed some major successes in command/control in organization 5200 in the last year, and those will lead us, I think, toward automating emergency action messages. This is important because, as one looks more toward a more selective release capability for weapons than what exists today, simply handling and moving the amount of information involved — almost down to the level of serial numbers — will be a major task. A new system will have to build on computer technology, automation, and so on. 5200 is already involved in that project and will play a key role. And Gus Simmons has been and will continue to be a principal architect. We have an internal working group, which has been chaired by Bill Alzheimer [then 5120; now 2800], that's developing an overall strategy — that is, looking into what is required in the emergency action messages that link users to a weapon itself, and making full use of the capability that we're building into the weapons. The activity shows a budgeted increase in 87.

SLN: What's involved in such a system?

Jones: Message handling, formatting, recoding, and all. It includes such goals as fewer demands on the human, better protection of the information — in effect, keeping everything encrypted until the very last moment and doing the decrypting automatically inside the device itself. I see command/control as an active area for us in the next half dozen years.

Welber: You see, in the past we saw our responsibility as, and we confined our attention to, the shell of the weapon and what's inside it. Now, weapons have become more complex, they are spread out geographically, and the chain of command that controls their use has become longer. If you are really concerned about the security of the information you're passing along, and if you want the order, which may start at the President's desk, to travel reliably down this chain of command and eventually arm or disarm the weapon — then you've got to consider every link in the chain.

I think what we have to do — working with the appropriate services and agencies — is to consider how that information flows, how it gets handled, and how it eventually reaches the weapon reliably and quickly and securely.

SLN: Is this a new initiative?

Jones: I wouldn't say a new initiative. Over the years we've made some major contributions in this area. Once again, the time is appropriate, the technology is available, the concerns and interest are there. It's a clear Sandia responsibility to move forward again here.

Welber: It certainly relates to our capabilities in terms of information handling, cryptography, security of intelligence. And it relates to our understanding of the weapon itself and to our sensitivities in regard to the arming and disarming of the weapon.

But I think that's really all we can say here. Obviously, we're touching on the "hows" of weapon release and security. Those are areas that we really can't talk about in depth. And there are others — such as work for other members of the intelligence community — that are extremely important to the country, but we are not free to discuss them. Many of our people are really heroes but, unfortunately, can't receive the public recognition they deserve . . . but those of us in management know who they are.

SLN: Let's talk about something safer. What's happening in ACMs [advanced conventional munitions]? Are we at our limit in the amount of budget we can apply to that? Or are we limited?

Welber: I think we are limited in two ways. We think that it would be prudent to maintain our total laboratory size roughly where we are. And we feel our sponsor, DOE Defense Programs, would like to provide at least 50 percent, if not more, of our budget. You take those two limits and you look at our

commitments to SDI, energy, and the other programs, and then you begin to get a feel for the amount of effort we can expend on ACMs for DoD and other agencies. Now, I think we can take on some work, but we want to make sure it strengthens, it adds to, the technology that we are generating for DOE's Defense Programs.

Jones: And we're very much in favor of that — having a prime sponsor and a prime mission is very

We are caretakers of the national strategic capability and the weaponization of nuclear explosives. —Jones

important. A prime sponsor makes possible the level-of-effort concept that we've enjoyed over a long period of time and that we want very much to maintain [see "Cancellation with a Bright Side"]. A prime mission provides the focus that makes our work successful.

We are, in effect, caretakers — trustees, if you please — of the national strategic capability and the weaponization of nuclear explosives (a term, incidentally, that I prefer to "non-nuclear ordnance" because I think it expresses better what we do). Our special capabilities are in electronics, firing functions, firing systems — all those things that are at the heart of conventional weapons. And we're choosing a selection of ACM projects that are, in practically every case, completely complementary to our ongoing nuclear weapon interests. We can and will feed nuclear weapons technology into ACM work, but I fully expect that advances in some of those ACM areas will feed back into the nuclear weapons area.

SLN: For example?

Jones: Look at some of the new miniature quartz-transducer technologies for accelerometers, simplified inertial measuring units, and so forth. That's something that has immediate interest for smart conventional munitions, but I'll bet before we're done, we're going to find applications feeding back into our environmental sensing devices for nuclear weapons.

SLN: Have we already made any unique contributions to the smart munitions area?

Jones: An area that our sponsors are very excited about is in testable, programmable fuzes for conventional explosives, so that you don't have to have several different fuzes, depending on the particular target. You basically would have only one fuse that can be programmed for the particular job that you want the weapon to perform. It's buildable in a sort of flat, stripline technology so that it can all be laid down as one manufacturing process.

Another is safer initiators that use secondary, rather than primary, explosives with slapper detonators — again all built in a striplined process.

The 'Energy Missionary' Role

SLN: How about the future of our energy programs?

Welber: We've seen a cutback in the seabed disposal work, and we're phasing out that program. And we've also seen a reduction in some of our other energy work in line with the President's initiative to encourage industry to pick up some of this research — which, unfortunately, it has not. That gives us great concern — we've said it over and over again — that the nation is going to have an energy problem in the foreseeable future. It may not be too far off, as we import more and more oil. The U.S. is not doing what is needed today to improve the recovery of its resources. I think that's a shame, I really do. We're going to try to make the administration as aware as we can of these issues, and we're going to try to stay ready to respond when the time comes. But right now there is not the support for energy programs that I think this nation really deserves.

SLN: You're talking long-term energy programs, looking toward the needs of the 21st century, right?

Welber: That's right. This whole issue of exploitation of our coal resources. Improved oil recovery. We probably leave 50 to 60 percent of our oil in the ground because it's difficult to recover — and, hav-

ing left it there, it's going to be even more difficult to recover when we need it later. That is a waste of an important resource.

Jones: We've also got to remember that the deficit problem is still with us. That's going to require us to be very responsible and focus our work well so we can remain active in the energy area. The bad news is that the nation's energy program has been decreasing; the good news is that Sandia's fraction of that decreasing program has increased. I think that's a nice tribute from the people who fund us — it says that our work has been on target and has been well executed and effective.

The fact is, we're pressing hard. We're taking the position that we need to be missionaries in this area of energy. Dan Hartley [VP 6000] and I feel the area of coal science is extremely important for the nation, especially as we've drifted away from a nuclear power option. We're going to have to have power from one source or another. It's going to be basically fossil, and the major U.S. resource is coal. We're concerned with coal conversion processes: How do you burn it to get heat, how do you liquefy it to get liquids for running our cars? We've taken the initiative in pulling together "Coal 2000," a kind of a Western-U.S. coal alliance involving a number of labs. DOE headquarters was impressed enough to fund this alliance at a \$1 million level. It's what I mean by the missionary approach that's needed to alert the nation.

Welber: Sandia commands a lot of respect in Washington, and if you have some respect and if you're willing to be a missionary — without being overly zealous — you can accomplish a lot.

Jones: We also think there are opportunities in related geosciences activities. And the time is right to revisit some of the nuclear reactor concepts for future power production.

Welber: In talking with William Graham [now the President's Science Advisor and head of the Office of Science and Technology], I found that he is very enthusiastic about working with Bill Snyder on our new initiative for the nuclear industry. He met with Bill when he was out here for our Large Staff Conference and was very impressed with what he heard. He's a listener and he's intelligent so he's a good source to start out with. If we can affect the President's thinking on this and get it started from the top, we can accomplish something. So we are starting, we hope, with the right constituencies. That's the thinking behind the new 6500 directorate that we formed to concentrate on revitalizing nuclear power for the next few decades [see LAB NEWS, Jan. 30, 1987].

Work for Others: We're Picky

SLN: We mentioned ACM work earlier, but let's look at the philosophies underlying work we're doing — or being asked to do — for others, "reimbursables," we've traditionally labeled them. Any changes in direction?

Welber: No. We're careful to examine proposed reimbursables in light of our mission. And we have on numerous occasions decided to turn down what appeared to be an attractive reimbursable that involved a considerable amount of money because we felt it did not fit with our goals and our mission. We select our reimbursable programs with great care.

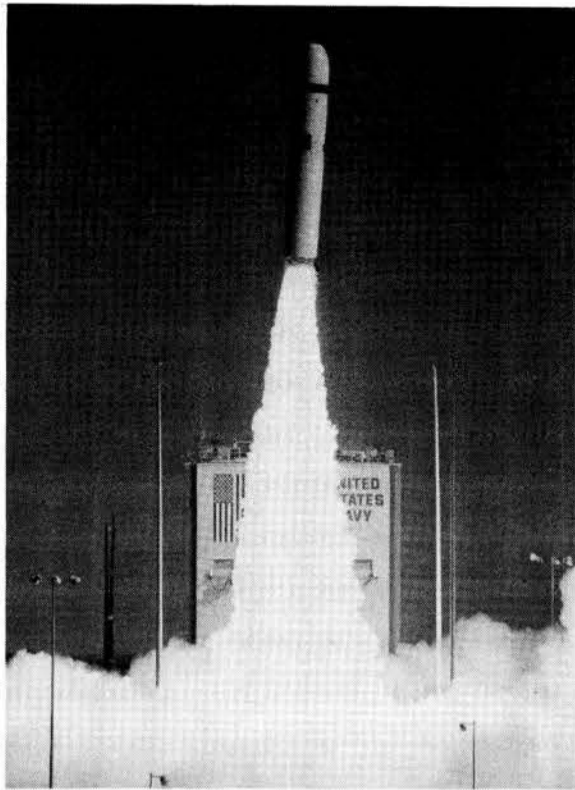
Jones: Very true. We try to pick projects that maintain our capability to do our prime mission, nuclear weaponization, and at the same time make major contributions to, and advances for, our reimbursable customers. We want to employ our staff in ways that build the strength of the Labs, and that's working nicely.

Welber: Of course, as times get tight, we may have to be a little more lenient in our selection, but we have not gotten to that point yet.

SLN: Do you think we can still be picky in the next few years?

Welber: I hope we can. I really hope we can. I hope we have enough people who want our services so that we'll have enough choice to be really selective.

Jones: We're certainly still able to be picky in 87. No question about that. One very large reim-



FIRST DEVELOPMENT FLIGHT TEST of the Trident II, with a Sandia-developed arming, fuzing, and firing system, took place on the precise date scheduled two years ago, Jan. 15. Launched from Cape Canaveral, the system "worked incredibly well," says John Duncan, supervisor of Trident II Test and Evaluation Division 5152.

bursable job that we prize greatly is the integration of the Trident II arming, fuzing, and firing function between DOE and the Navy. That program is coming along very nicely. It's a little too early to pat ourselves on the back, but the first flight test a couple of weeks ago was a resounding success. The program has involved very significant technology advances for us — from battery technologies to radars to radiation-hardened microcircuits to memory devices, and many others.

That work is at its peak right now, and as we transfer that development job to the production complex, the number of Sandians applied to it will be going down. This will provide some freedom and flexibility in other areas, such as ACMs, where we may want to build up.

SLN: Another large reimbursable program has to be the various tasks we're performing for the SDIO [Strategic Defense Initiative Office].

Jones: SDI is growing a lot. We're trying to pick and choose carefully those things that fit us, those where we're satisfied that we can make a contribution.

SLN: Do we have a track record there yet?

Welber: We have a track record in the sense that we're doing some very effective systems analysis work, examining the vulnerabilities of the proposals for SDI. It's a very delicate kind of mission.

SLN: You mean proposals by other organizations?

Welber: I'm referring to the various technologies that are being proposed for various parts of the SDI program, whether they apply to the launch, mid-course, or terminal phase. And we are, in as objective a way as we know how, examining the effectiveness of these weapon technologies.

Jones: And that involves trying to understand the nature of the Soviet threat that we would have to protect against — its soft spots, how they could counter our defense, and so on. Certainly many things we've been doing over the years — launching small instrumentation rockets, building instrumented reentry vehicles — make us a very useful resource to SDIO.

In many areas we could perhaps do even more work than we are. But we're trying to maintain a prudent balance in those technologies where we can really have a major effect.

Welber: And we can have a major effect. We bring something unique to our work in SDI — when we do systems analysis, whether it's decoy detection or whatever, it's based on a knowledge of hardware. We have people who have built these things, measured them, and understand them physically, and they understand the physics involved. So when we make an analysis, it's not based solely on paper, it's

based on experience as well. That's unique. It really is. We're not just a think tank.

Tech Transfer: Mandated But Perplexing

SLN: Do you see changes coming up in technology transfer?

Bray: We've seen some changes; I think we're going to see more.

SLN: For example, in the area of consulting?

Welber: We're examining it right now. We recently reviewed with Los Alamos their consulting practices: "What's been your experience? How do you like it?" And I came away from that with "Go slow." It's a difficult problem.

Jones: The problem with consulting is that we have the concept of exempt professional employees. The idea is that we hire professional employees and pay them a professional salary, so we really expect each one to bend his or her thoughts both within the 40-hour week and perhaps outside that — whatever's required, within reason — to our job. And one of the fundamental conflicts you get into is, if a person is doing heavy consulting and being paid by somebody else, is Sandia getting the "professional exempt employee" benefit that it expects and is paying for?

Bray: If Los Alamos has a problem, we're going to have at least as big a problem here.

Welber: And our mandate to transfer technology does not mesh smoothly with Bell Labs practice.

Bray: Certainly local conditions are different. And our contract with AT&T allows us to deviate from AT&T practice in that case [see "AT&T, Bell Labs, and Sandia"].

Welber: For example, Bell Labs, as a matter of policy, does not permit consulting. But we are under a mandate from DOE to transfer as much technology as we can to industry. One of the means to accomplish that is to let an inventor work in some way with a company that's trying to commercialize the invention. Consulting is one way. So that's something that we must examine further.

Admiration, Admonitions, Adios

SLN: In ending our "State of the Labs 86," what final comments would you like to make?

Welber: Sandia is respected and supported. That brings with it a tremendous responsibility to perform. We can't rest on our laurels; we have to continue to earn that respect.

SLN: You see that as our main challenge in the foreseeable future?

Welber: Well, our sponsors have put Sandia on a pretty high pedestal.

SLN: We're still regarded very highly.

Welber: Absolutely. More than ever. Ray Romatowski [AL Manager] told me that Admiral Foley [DOE's Assistant Secretary for Defense Programs] came away from his annual assessment review here

We've earned an excellent reputation, but we must work hard to continue to deserve it. —Bray

with very positive feelings about Sandia — about our performance and how he felt this place is run.

Bray: We've earned an excellent reputation — and enjoy the fruits of it whether we see evidence of it every day or not — but we must work hard to continue to deserve it.

Welber: Our funding is one evidence of that.

SLN: Orval, how about our sponsors outside DOE?

Jones: I think we're held in uniformly high regard by virtually everyone. Although it's hard to see the future with much certainty right now, Sandia is strong, and we have an outstanding staff and a reputation for getting things done. We intend to capitalize on that.

Bray: I agree. We've got an excellent team, and we're playing in most of the right ballparks. Our opportunities to be in the right place at the right time are probably as good as they've ever been, and we just need to continue to work hard and be alert. ●BH